ISBN 0-7729-0493-6





# HISTORICAL DEVELOPMENT AND QUALITY OF THE TORONTO WATERFRONT SEDIMENTS - PART 1

MAY, 1985

Ontario

Ministry of the Environment

The Honourable
Susan Fish
Minister

Dr. Allan E. Dyer
Deputy Minister

# HISTORICAL DEVELOPMENT AND QUALITY OF THE TORONTO WATERFRONT SEDIMENTS - PART I

MAY, 1985

Prepared by:
D. Persaud, T. Lomas, D. Boyd and S. Mathai
Great Lakes Section
Water Resources Branch
Ministry of the Environment



ISBN 0-7729-0493-6

TABLE OF CONTENTS

TABLE OF CONTENTS - (Cont'd)

LIST OF FIGURES

## APPENDIX

APPENDIX(cont.)

## LIST OF TABLES

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of Mr. J. Ralston, Mr. R. Shaw, Dr. R. Weiler, Mr. F. Fleischer and Mr. A. Hayton from the Ministry of the Environment, Dr. Katherine Davies from the City of Toronto and Mr. B. Hindley from the Metropolitan Toronto and Region Conservation Authority, in reviewing the draft report and providing valuable suggestions; Mr. A. Strileski and Mr. R. Shishkoff who prepared the figures and Ms. V. Sokolyk and Ms. E. Lacson for typing the report. The 1976 to 1980 sediment data used in this report were collected by Ms. M. Griffiths of the Great Lakes Section. These data formed a significant part of the historic background upon which the interpretations were based.

## SUMMARY

Part I of the Toronto Waterfront Sediment assessment is designed to show the historical formation and development of Toronto nearshore sediments and to provide good baseline information on contaminant levels in the sediments sampled between the period of 1976 to 1983. Preliminary studies were reported by the Ministry in 1974.

The analytical results presented are evaluated in light of the Ministry Dredged Material Disposal Guidelines (1976). These Guidelines are used routinely to assess the suitability of dredged material for open lake disposal. Parameter values in excess of the numerical Guidelines suggest that contamination of sediment has taken place while sediments with parameter values less than the guidelines are considered clean and acceptable for open water disposal.

High levels of contamination were found in sediments of Humber Bay, the Inner Toronto Harbour and Ashbridges Bay. However, it must not be construed that parameters with levels in excess of MOE guidelines will have a discernible impact on water quality or aquatic organisms. The significance of contaminant levels with respect to potential impacts will be examined in Part II of this study (1985).

The water supplies at both the R.C. Harris and the Island filtration plants were monitored during recent years to determine any potential impacts of contaminated sediment movement from dredging and lakefilling activities. The results have shown no discernible effects attributable to sediment movements since water supplies at both plants remain of excellent quality.

## Humber Bay

There do not appear to be any marked changes over time in sediment type or quality in Humber Bay based on MOE Survey results between 1979 and 1982.

The surficial sediments in the deeper, central portions of the Bay consist primarily of fine material with coarser material near the shoreline of the Bay. The portion of Humber Bay bordering on Toronto Island consists of clean sands which form a narrow band that extends northwards to a point immediately west of Ontario Place. Sediment quality distribution in Humber Bay appears to correspond to the sediment type distribution. The coarser material around the shoreline of the Bay, outside of the breakwalls, is relatively clean. Progressing inwards to the Bay, the degree of contamination increases uniformly to a point roughly 2km south of the Humber Bay Sewage Treatment Plant (STP) outfall. From this point to the Humber River mouth and about 1.5km on either side of the STP discharge pipe, is a zone of heavily contaminated sediments, based on measurements of loss on ignition, nutrients, metals, solvent extractables and PCB's. In contrast, the coarse sediments at stations close to shore (outside the breakwall) and in the western part of the Bay, are clean.

The quality of the sediment inside the Humber Bay breakwall is variable. The materials at those stations close to the Humber River mouth and in the vicinity of the Boulevard Club, consist of coarse, clean sediments. Other stations show mainly silt with small amounts of sand and clay, with elevated levels of phosphorus, cadmium, copper, chromium, lead, zinc, oil and grease and PCB's.

The poor quality of sediments along the central portion, inside the breakwall, is perhaps a reflection of inadequate dispersion of contaminants and contaminated sediments entering the area from outside the breakwall or from urban storm drainages.

Humber Bay Park

The two stations that were sampled in the Humber Bay Park lakefill embayments show elevated levels for loss on ignition, nutrients, PCB's amd oil and grease. The sediments at the station in the eastern embayment were highly contaminated. This embayment likely traps material from the Humber River discharges.

Toronto Harbour

In Toronto Inner Harbour, distinct zones can be identified (boat slips, Island waterways, main Harbour and Keating Channel) with varying degrees of contamination.

The sediment found in the boat slips and the waterways between the islands show greatly elevated levels for loss on ignition, nutrients, metals, solvent extractables and PCB's. The main Harbour sediments are less contaminated than the slips. The Keating Channel (located at the mouth of the Don River) sediments show material with elevated levels of phosphorus, chromium, copper, lead, zinc, iron, solvent extractables and PCB's. The sediments vary from coarse material near the Don River mouth to fine material at the lower end (west) of the Channel. The concentration of the contaminants in the Keating Channel sediments was generally lower than the rest of the Inner Harbour.

The Outer Harbour sediments are slightly coarser than the Inner Harbour sediments and are also contaminated. Stations near the shore show very low levels of metals whereas stations in the middle of the approach channel show elevated levels of chromium, lead, zinc, arsenic, oil and grease and PCB's.

In general, the sediments in the Inner Harbour are more heavily contaminated compared to the Outer Harbour.

## Toronto Island and Eastern Headland

The sediments on the Lake Ontario side of the Toronto Island are mainly coarse, clean material. Much of this material was derived from littoral drift originating from the Scarborough Bluffs. The exception to the otherwise clean area is a station located in the vicinity of the western water intake pipe (Island Filtration Plant), in a local depression. Fine sediment with elevated levels of copper nickel, zinc, oil and grease and PCB's appears to be trapped in this depression.

The sediments around the Eastern Headland vary in physical type and chemical quality. The area south of the Headland is moderately contaminated with respect to lead, oil and grease and PCB's. The sediments around the Headland appear to be influenced by material from the lakefilling activity at the Headland. The contribution from this source, however, cannot presently be clearly defined.

## Ashbridges Bay and Eastern Beaches

The station in Ashbridges Bay lakefill embayment is notably more contaminated than adjacent stations outside the embayment, with high levels of nutrients, PCB's, mercury, cadmium, chromium, copper, lead, zinc and oil and grease. The sediment along the Eastern Beaches sector is composed of coarse, sandy material found to be relatively clean at all stations. Exceedingly small elevations in phosphorus levels over the MOE Guidelines are noted at a few stations. These isolated pockets are most likely temporary deposits that reflect the influence of the Main Sewage Treatment Plant discharge in this area. Elevated levels in solvent extractables at a few stations and arsenic at one station in the vicinity of the R.C. Harris Filtration Plant intake are also noted. These stations are suspected to be in depressions where localized deposition occurs.

The Scarborough Bluff stations consist of coarse, sandy sediments that are clean. The sediment station located at the mouth of Highland Creek shows elevated levels of oil and grease.

## Conclusions

Considerable variation exists in sediment quality and type across the Toronto Waterfront. The two major factors influencing these sediment characteristics appear to be local discharges and lake hydrodynamic forces (waves and currents). Areas such as the Scarborough Bluffs - Eastern Beaches sector of the Toronto Waterfront which is frequently exposed to waves and littoral currents, especially from the east, consist primarily of clean, coarse-grained material. Other areas such as the lakefill embayments, Ashbridges Bay and Toronto Harbour are not under the influence of any significant water movement that would disperse fine materials and contaminants. Discharges to these areas result in local areas of degraded bottom sediment.

The most degraded areas on the Waterfront are the Inner Toronto Harbour and Humber Bay. Localized pockets of less contaminated sediments are also found throughout the waterfront. The Inner Harbour sediments are relatively confined and present no direct potential for redistribution. The pattern of contaminant distribution within Humber Bay, however, requires further assessment. The build-up of contaminated sediments in the southeastern portion of the Bay suggests continued contaminant loading to the Bay with diminishing influence from waves and currents and possibly reduced drift of clean littoral sands from the east. The construction of the Eastern Headland could be the governing factor.

# CHAPTER 1 - INTRODUCTION

An understanding of the role of sediments in transport and fate of environmental contaminants has taken on increasing significance over the last decade. Concerns over contaminants in sediments became apparent in the 1960's due mainly to redistribution of contaminants from polluted harbours through open-lake disposal of dredged material. As a result of these concerns, several studies were carried out through the U.S. Army Corps of Engineers' DREDGED MATERIAL RESEARCH PROGRAMS (DMRP*) to address issues associated with contaminants in sediments.

The DMRP and other similar studies suggest that contaminants in sediment present a potential to affect water and biota. Contaminants in sediments, referred to as 'inplace pollutants', contribute to the degraded state of almost all of the Class 'A' Areas of Concern around the Great Lakes (IJC, 1983). In the overall effort to identify and control sources of pollution, contaminated bottom sediments warrant careful consideration since such material can directly contribute contaminants to overlying water, bottom dwelling organisms and fish that feed on these organisms.

The monitoring of water provides information on transient phenomena, whereas sediments provide a long-term record of pollution. Many heavy metals and organic trace contaminants have a strong affinity for sediments, especially the fine-grained sediments such as silts and clays (Forstner and Wittmann, 1981). When contaminants enter the aquatic environment, they are adsorbed onto particulate matter with which they are transported and eventually deposited within the aquatic system.

---

* In 1973 the Corps initiated a 5-year ($30M) program which resulted in over 250 studies designed to provide an understanding of processes and mechanisms associated with impacts from dredged material disposal.

Most contaminants and contaminated sediments enter a lake via rivers, urban runoff (e.g. storm sewers) and municipal and industrial discharges. In the lake environment, coarse-grained material such as sand will settle out of the water column rapidly, while the finer material which carries the bulk of the contaminants will be transported over greater distances (Forstner and Wittmann, 1981).

The nearshore transport of sediments in a lake depends on waves and currents. In areas where the influence of these forces are minimal, such as in harbours, embayments, and the deeper portion of lakes, the material carried in suspension will deposit on the bottom. In some instances, deposition in these areas is temporary, and material can be resuspended and transported several times before coming to rest at a long-term depositional area.

Studies to date have not clearly defined the fate of contaminants associated with bottom sediments in a lake, but they do point to various potential effects of such contaminants. Bottom dwelling or benthic organisms can take up the contaminants from the sediments through food and transfer these contaminants via the food chain to higher organisms such as fish. The process of desorption of contaminants from the sediments which releases them to the overlying water column, can occur as a result of physiochemical changes, in such parameters as Eh (oxidation - reduction potential) and pH. In some instances, sediment associated contaminants may adversely afffect benthic organisms (Rubinstein et al, 1980).

The Ministry, through its 'Inplace Pollutants' program initiated in 1983 and ongoing fish sampling program, is assessing the impacts of contaminants in Toronto Waterfront sediments on the aquatic ecosystem. This assessment which will form Part II of this report will include a review of pertinent literature and evaluation of the inplace pollutants data to determine the bioavailability of metals, levels of contaminants in benthic organisms and the relative ease with which metals can be released from sediments to the overlying water. This information will be available in 1985.

## 1.1 Background

In 1974, the Ontario Ministry of the Environment (Wilkins, 1974) released a publication documenting the physical and chemical characteristics of the Toronto Waterfront sediments. The purpose of the studies documented in that report was to determine the influence of various construction activities such as lakefilling and dredged material disposal on waterfront sediments. Subsequent to the 1974 publication the Ministry has periodically resampled the surficial sediments along the Toronto Waterfront area.

The objectives of the various sediment quality assessments have been to examine the differences in sediment quality along the Toronto Waterfront. This is especially important in light of the numerous modifications, such as lakefill construction, to the Toronto Waterfront area. Any influence of these structures on nearshore lake circulation and the possible addition of contaminated material may result in changes in the nearshore sediment quality.

This report summarizes sediment data gathered between 1976 and 1983. The information is presented according to areas studied - Etobicoke Creek to Humber Bay; Toronto Islands and Eastern Headland; Toronto Harbour; and the Eastern Beaches to Highland Creek. Within these areas the data are presented according to the year in which they were collected. The intent is to present the data by delineating zones of varying degrees of contamination on maps by contouring the parameter concentrations. The guidelines for open water disposal of dredged material (Persaud and Wilkins, 1976) provide the basis for designating contaminated versus clean material.

It must be pointed out that the guidelines relate mainly to the chemical quality of the sediment and it should not be construed that levels of parameters in excess of the guideline imply detrimental water quality or biological effects. Studies are currently underway to assess the biological and water quality impacts of various levels of contaminants in sediments. The findings of these studies to be published in 1985 will form Part II of this report.

The potential sources of sediment contamination in the Toronto Nearshore can only be identified in a general way since the hydraulic information needed to accurately quantify and trace the various inputs is unavailable.

# CHAPTER 2 - GENERAL INFORMATION

## 2.1 Location and Description of the Study Area

The study area is located on the northwestern shore of Lake Ontario and covers the nearshore area of Toronto bounded by Highland Creek in the east; Etobicoke Creek in the west; the shoreline of the Toronto area (Toronto Harbour included) and roughly the 20 meter(m) depth contour on the lakeward side. See Figure 2.1 for the study area.

## 2.2 Climate

Toronto is located in the Great Lakes - St. Lawrence climatic region (Hare and Thomas, 1974). This zone, which is between 300 and 500 kilometers(km) wide stretching from Windsor to Quebec, is affected by combinations of Arctic, Pacific and Tropical Gulf air masses and the climate is therefore inherently variable. Prolonged periods of precipitation, drought, or extreme temperature fluctuations are unusual.

The local climate of Toronto is basically continental, but is modified by the Great Lakes. Monthly precipitation totals do not vary greatly over the year, although summer totals are dominated by local convective storms rather than the cyclonic events which prevail throughout other seasons.

## 2.3 Wave Climate

The prevailing winds in the Toronto area are from the northwest (blowing offshore), southwest (blowing onshore) with other winds of significant duration from the east, west, northeast, southwest and southeast, respectively. With regard to the generation of waves along Toronto Waterfront, the most significant winds are those blowing


FIGURE 2.1
STUDY AREA

Ministry of the Environment
Ontario

from the east. These winds blow over the maximum fetch (distance over which winds can blow unimpeded) of approximately 260km and generate the largest waves in the Toronto area. Other significant wave generating winds reaching the Toronto area are from the southeast, south and southwest. The storm season extends from November to April with calmer periods between May and October (Greenwood and McGillivray, 1978).

Current understanding of the wave climate of the Toronto area is based primarily on the work of Fricbergs, (1970). He used the Sverdrup-Munk-Bretschneider (SMB) wave hindcast method and wind data from the Toronto Island Weather Station for the period between August 1948 and July 1964 to derive the frequency of occurrence of various size waves.

Greenwood and McGillivray (1978) estimated significant wave periods for each of the significant wave heights studied by Fricbergs. This information is presented in Table 2.1. Figure 2.2 shows the significant wave roses for Toronto Waterfront.

## 2.4 The Toronto Shoreline

The present configuration of the Toronto shoreline is the result of approximately 150 years of continuing change (Figure 2.3). Existing waterfront and harbour facilities have, for the most part, been created through filling operations which first began in 1840. This first filling operation was undertaken in an effort to create an esplanade approximately 100m out into the lake (CWPC*, 1976). Toronto Island was originally the tip of a peninsula which joined the mainland at the eastern end of Ashbridges Bay immediately to the east of the Don River mouth. Although the peninsula was repaired after being

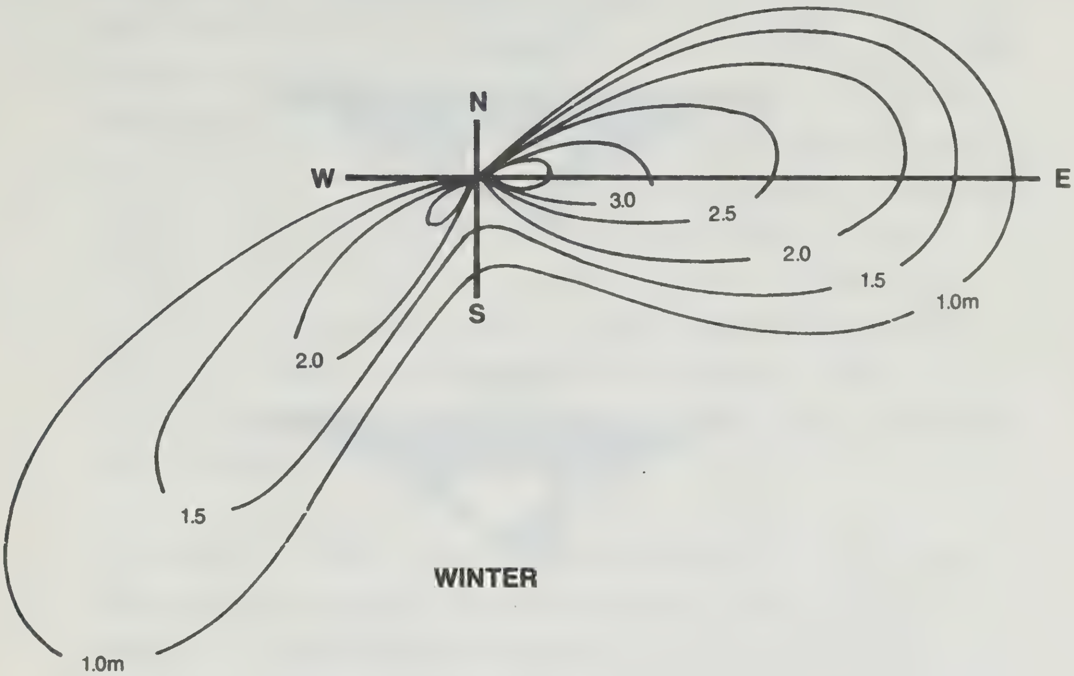
---

*CWPC - Central Waterfront Planning Committee

Table 2.1 - Average Hourly Wave Frequency per Year - by direction, significant heights (Hs) and significant periods (Ts) - for the Toronto Waterfront area

| Waves Approaching From | Wave Class By $H_s$ (ft) | $H_s$ (m) | $T_s$ (sec) | Average Hourly Frequency per Year |
|---|---|---|---|---|
| East | 4- 5.9 | 1.5 | 6.8 | 6.7 |
| | 6- 7.9 | 2.1 | 7.4 | 10.9 |
| | 8- 9.9 | 2.7 | 8.1 | 9.3 |
| | 10- 11.9 | 3.4 | 8.7 | 2.5 |
| | 12- 13.9 | 4.0 | 9.3 | 0.4 |
| Southeast | 4- 5.9 | 1.5 | 5.5 | 3.3 |
| | 6- 7.9 | 2.1 | 6.3 | 1.5 |
| | 8- 9.9 | 2.7 | 6.8 | 0.2 |
| South | 4- 5.9 | 1.5 | 5.5 | 1.7 |
| Southwest | 4- 5.9 | 1.5 | 5.2 | 36.3 |
| | 6- 7.9 | 2.1 | 6.0 | 4.6 |
| | 8- 9.9 | 2.7 | 6.6 | 0.4 |
| | 10- 11.9 | 3.4 | 7.3 | 0.1 |

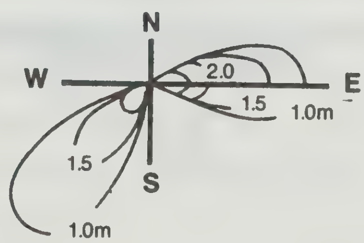
Adapted from Fricbergs, 1965 - length of record: 16 years 1948 (Aug. - Dec.) - 1964 (Jan. - July).
$H_s$ (m) represents average values of the $H_s$ (ft) range.
Greenwood and McGillivray, 1978.




WINTER

(NOV.-APR.)

5 HRS.
SEASON




SUMMER

(MAY-OCT.)

**FIGURE 2.2**
**SIGNIFICANT WAVE ROSES**
**ALONG THE TORONTO WATERFRONT**
**(K.S. FRICBERGS 1970)**

Ministry of the Environment
Ontario

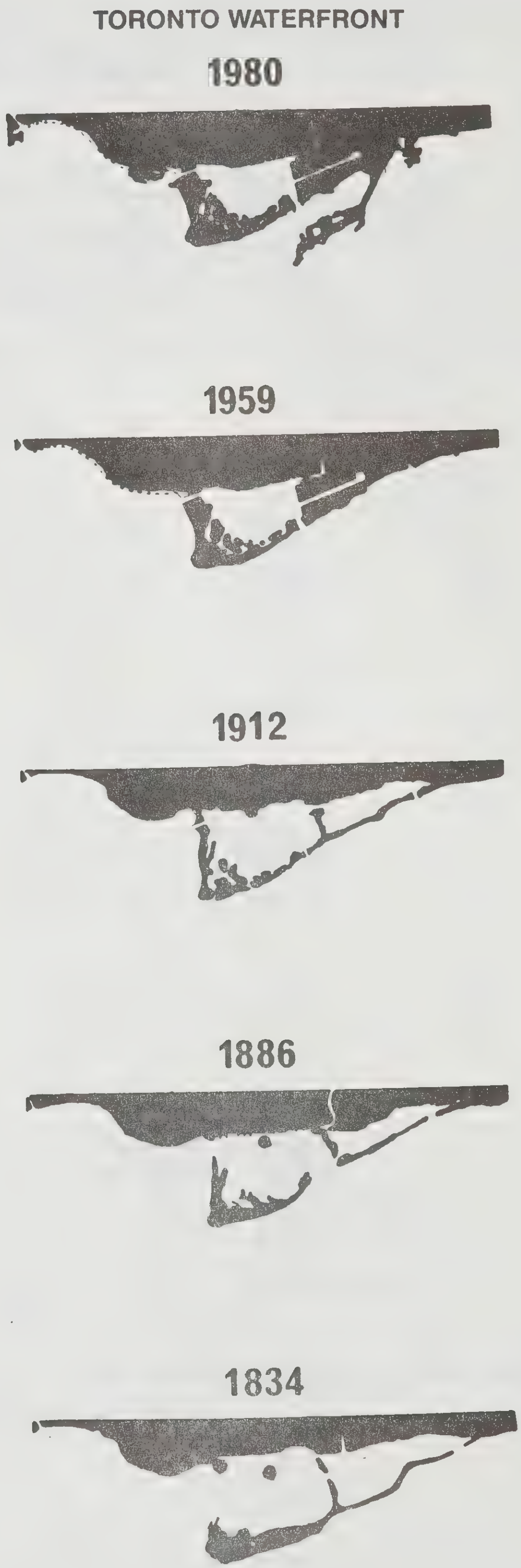



FIGURE 2.3
TORONTO WATERFRONT (THC 1982)

Ministry
of the
Environment
Ontario

breached by a storm in 1852, a break nearly 500m wide was left in place after another major storm in 1858. By 1882, erosion had widened this "East Gap" to about 1.5km and a 1.3km breakwater was constructed across the eastern end of the harbour, separating it from Ashbridges Bay. A 2km dyke was also constructed along the southern shore of the Toronto Island ending at the west side of the East Gap which was narrowed to 150m. In 1892, the East Gap was further narrowed and stabilized to a width of 122m, a dimension which remained unchanged until it was enlarged to 259m in 1973 and 1974 (CWPC, 1976).

By the early 1900's, the natural "West Gap", the original sole entrance to the protected harbour, was no longer capable of accommodating the larger vessels which were in use on the lakes. Since it was underlain by bedrock and could not have its capacity increased through dredging, a new western channel was constructed. This channel, 122m in width, and located approximately 400m south of the original entrance, was completed in 1911 (CWPC, 1976).

The year 1911 also saw the formation of the Toronto Harbour Commission which was established to modernize and industrialize the port. By 1912, this agency had produced a waterfront plan calling for extensive changes which were completed by the end of the 1930's. The following table summarizes the timetable and activities (Table 2.2).

TABLE 2.2 - Implementation of Waterfront Plan
(Adapted from CWPC, 1976)

| Year | Construction Activity Along Waterfront |
|---|---|
| 1913 | Harbour shipping channel dredged to 7.3m. Work commences on filling of Ashbridges Bay to create a new industrial area, shipping channel, and turning basin. |
| 1914 | Don R. diverted away from Ashbridges Bay into the harbour via a new channel at the foot of Cherry St. (Keating Channel). |
| 1915, 1916 | Area of Toronto Island increased through filling at Algonquin and Ward Islands. |
| 1917 | 33ha of the new industrial area now completed. |
| 1921, 1922 | Existing central harbourfront shoreline constructed (between Bay and Simcoe Streets). 87ha added to waterfront west of harbour. 226ha of industrial area completed. Shipping channel and turning basin operational. |
| 1925 | Construction of breakwater from West Gap to Humber River. |
| 1929 | Construction of bridge over shipping channel. Completion of further 82ha of industrial area. |
| 1933 | Sunnyside beach established (also referred to as the Western Beaches). |
| 1937-1939 | Filling to create additional land for Island Airport. |

(No major filling activities were initiated in the 1940's although maintenance filling was performed).

## 2.5 Recent Shoreline Modifications

In 1960, the Toronto Harbour Commission began a fill project at the foot of Leslie Street which continues today. The original rationale for the undertaking was to create additional harbour space through construction of a protective spit extending into the lake in a southwesterly direction. This "Eastern Headland" (also referred to as the "Leslie Street Spit") was later modified to include the construction of an "Aquatic Park" through additional filling on either side of the original spit. The additional harbour space is known as the "Outer Harbour".

The Eastern Headland now extends about 5km into the lake and has been constructed primarily from building demolition rubble and excavation material. The Aquatic Park fill consists chiefly of material hydraulically dredged from the East gap during the widening and deepening which took place in 1974 and 1975. In 1979 construction of an endikement on the southern side of the spit was undertaken specifically for the disposal of Inner Harbour dredged material. This latter project is still in progress. Between 1956 and 1982, the following totals of fill had been placed in construction of the headland, park, and endikement: 17,037,554 $m^3$ of trucked fill and 8,034,912 $m^3$ of dredged material, for a total of a 25,072,466 $m^3$. Approximately 188ha of new land has been created over the project life (THC, 1983).

During the 1970's, three lakefill parks were constructed by the Metropolitan Toronto and Region Conservation Authority (MTRCA). At Humber Bay, 45ha of land was created through the addition of about $5 \times 10^6$ $m^3$ of trucked fill from construction sites. The Ashbridges Bay lakefill at the foot of Coxwell Avenue is about 17ha requiring about $1 \times 10^6$ $m^3$ fill and at the foot of Brimley Road, 30ha of

land formed the Bluffers Park lakefill which required about $2 \times 10^6$ $m^3$ of trucked fill. A fourth major recreational lakefill project, the Col. Samuel Bois Smith lakefill, is currently underway at the foot of Kipling Avenue in the Borough of Etobicoke.

## 2.6 Bathymetry of the Toronto Nearshore Area

The shoreline in the vicinity of the Toronto Harbour is low and is composed predominantly of geologically recent sand and silty-sand deposits. Historically, these deposits were derived from the erodible Scarborough Bluffs approximately 8km to the east of the harbour (the intersection of existing and Iroquois shorelines). Prior to the extensive modification of the natural shoreline, material was transported toward the Harbour from the northeast by the prevailing nearshore currents. This material was deposited in the region of the future Harbour forming an extensive spit and combining with sediment delivered by the Don River to create the Ashbridges Bay marsh and the shallow natural harbour (Lewis and Sly, 1971).

Progressing from the Toronto Island out into the lake, the significant bathymetric features encountered are the "Toronto Shelf", the "Toronto Scarp", the "Offshore Rises" and the "Niagara Basin" (Lewis and Sly, 1971). (See Figure 2.4.)

The Toronto Shelf slopes gently out from the Toronto Island shoreline until the 30m depth contour, a distance of approximately 2.5km. Further to the northeast, in the vicinity of the Scarborough Bluffs, the feature broadens to about 4 km, while to the southwest it diminishes rapidly. In general, the contours of the shelf closely parallel the existing shoreline which, in combination with sediment composition, suggests that it has developed from littoral erosion over the last several thousand years (Lewis and Sly, 1971).

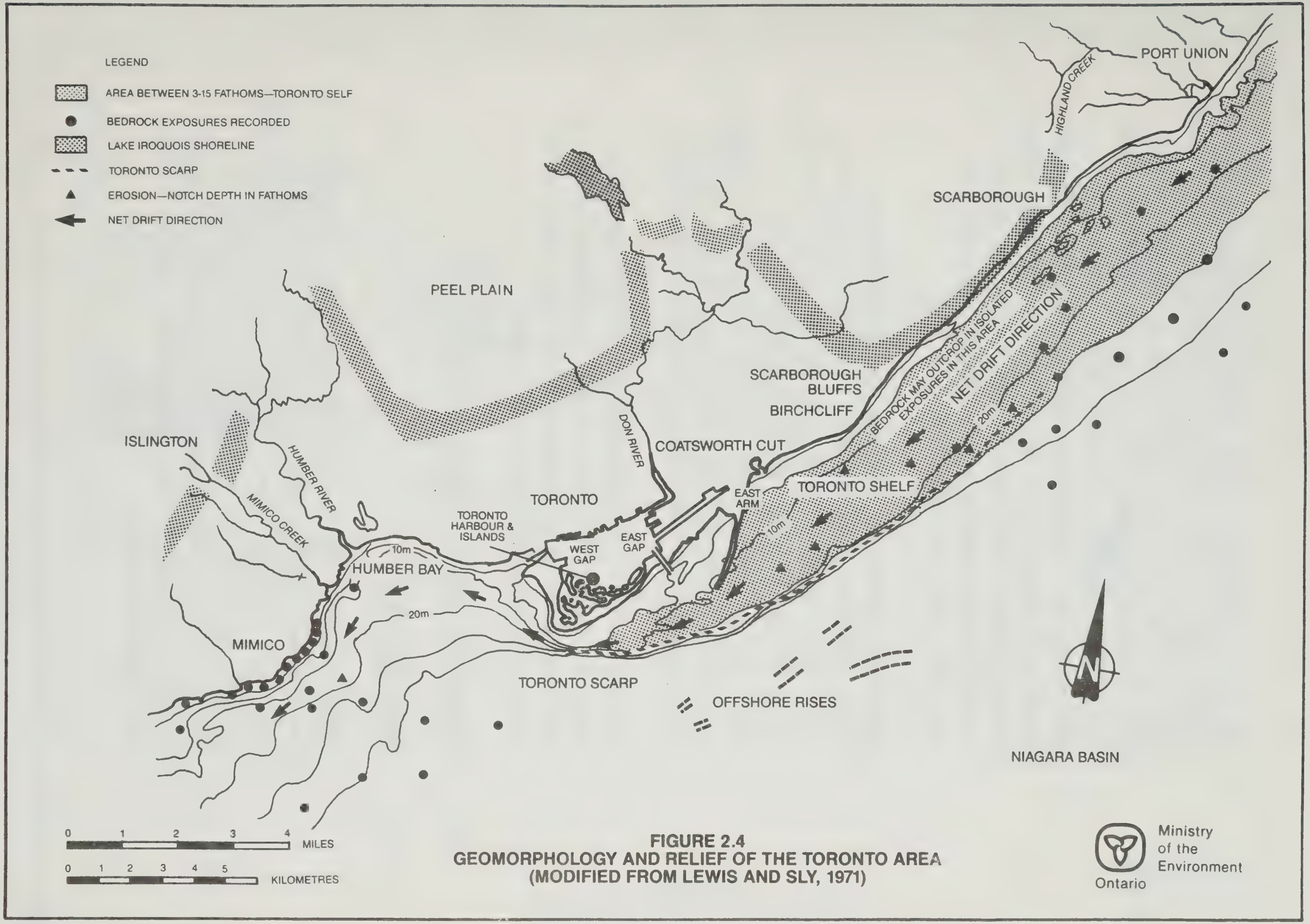



**FIGURE 2.4**
**GEOMORPHOLOGY AND RELIEF OF THE TORONTO AREA**
**(MODIFIED FROM LEWIS AND SLY, 1971)**

The southern extremity of the shelf is delineated by the Toronto Scarp. In the vicinity of this major discontinuity, depth increase from 30m at the edge of the shelf to 60m at the foot of the scarp with slopes reaching 1:6, although gradients of about 1:10 are more usual. These slopes are in marked contrast to the general regional gradients of between 1:150 and 1:200 and are thought to be primarily an erosional feature since bedrock and glacial and post glacial deposits are believed to outcrop in the scarp face (Lewis and Sly, 1971).

Progressing further out into the lake the presence of slight, anomalous rises have been reported (Lewis and Sly, 1971). These Offshore Rises appear to vary in width from 30m to 300m and in height from 1.0 to 2.4m. It is postulated that they are the result of a shear zone between the relatively high velocity nearshore current and the low velocity, deep-water basin current (Lewis and Sly, 1971).

The Niagara basin, the westernmost of the four sub-basins within the major lake Ontario basin, lies between 10 and 15 km offshore from the Toronto Waterfront area. Opposite the Toronto Island, it lies about 13km offshore.

## 2.7 Sediment and Potential Contaminant Sources

### 2.7A Toronto Nearshore

Toronto nearshore sediments are derived mainly through shoreline and bluff erosion, stream discharges and urban discharges. The major source of the Toronto nearshore sediments appears to be the shoreline and bluff erosion (Rukavina, 1976). With respect to contaminants, the bluff material is relatively clean compared with sediments from other waterfront sources.


**FIGURE 2.5**
**WATERFRONT INTAKES AND OUTFALLS**

Ministry of the Environment
Ontario

Stream discharge represents the second major source of sediment to the waterfront. Etobicoke Creek, Mimico Creek, Humber River and Highland Creek discharge to the nearshore, while the Don River discharges into the Toronto Harbour. Information on the chemical quality of sediments in Toronto area streams are becoming available through an extensive Waterfront study conducted by the provincial and local governments. Many of these streams receive direct and indirect urban discharges which would result in varying degrees of sediment contamination.

The third major source of sediment and the major source of contamination to the Waterfront appears to be sewage treatment plants (STP) and storm sewer discharges. Figure 2.5 shows the various discharges along the Toronto Waterfront. The STP's discharging to the Toronto Waterfront include the Humber STP, Toronto Main STP and Highland Creek STP. Environment Canada (1981) estimated the solids loadings from the Toronto area STP's to be about 6,643 tonnes/year and 11,600 tonnes/year from combined sanitary and storm sewers.

The contaminant load is not unexpected since much of the material in these discharges are fine particulates which have high surface area to volume ratio and, therefore, can adsorb proportionately more metals and organic contaminants originating from urban sources,compared with coarse grained sediment.

## 2.7B Toronto Harbour

Sediment production in the drainage basin results partly from erosion of agricultural land in the headwater region, and mainly from the urbanized area to the south. Within the metropolitan region, there are a variety of potential sediment sources, with construction activity and instream erosion being the most probable major contributors. The general correlation between construction activity and sediment production is illustrated in Figure 2.6, which displays the annual totals of material dredged from the mouth of the Don River (the Keating Channel) for the period of 1950 to 1974. Those years in which major construction projects were undertaken within the river valley have been indicated.

Contaminants reaching the Toronto Harbour by means of the Don River originate from both point and non-point sources and can be grouped as: nutrients (e.g. nitrogen, phosphorous), trace metals (e.g. copper, lead, mercury) and organics (e.g. volatiles, oil and grease and PCB's).

The most significant point source within the basin is the North Toronto STP located approximately 2km downstream from the confluence of the East and West branches of the Don River. In addition to its direct discharge to the Don River, it is connected to the Main STP at Ashbridges Bay, immediately east of the Harbour. Non-point sources include diffuse urban storm runoff and atmospheric deposition.

Nutrient levels in the Don River result from both agricultural runoff in the northern portion of the basin and from the input of treated domestic and industrial waste at the North Toronto STP. Trace metal sources include treated domestic and industrial waste, urban runoff, and atmospheric deposition. Organic contaminant levels can be attributed to accidental spills, and treated domestic and industrial waste.

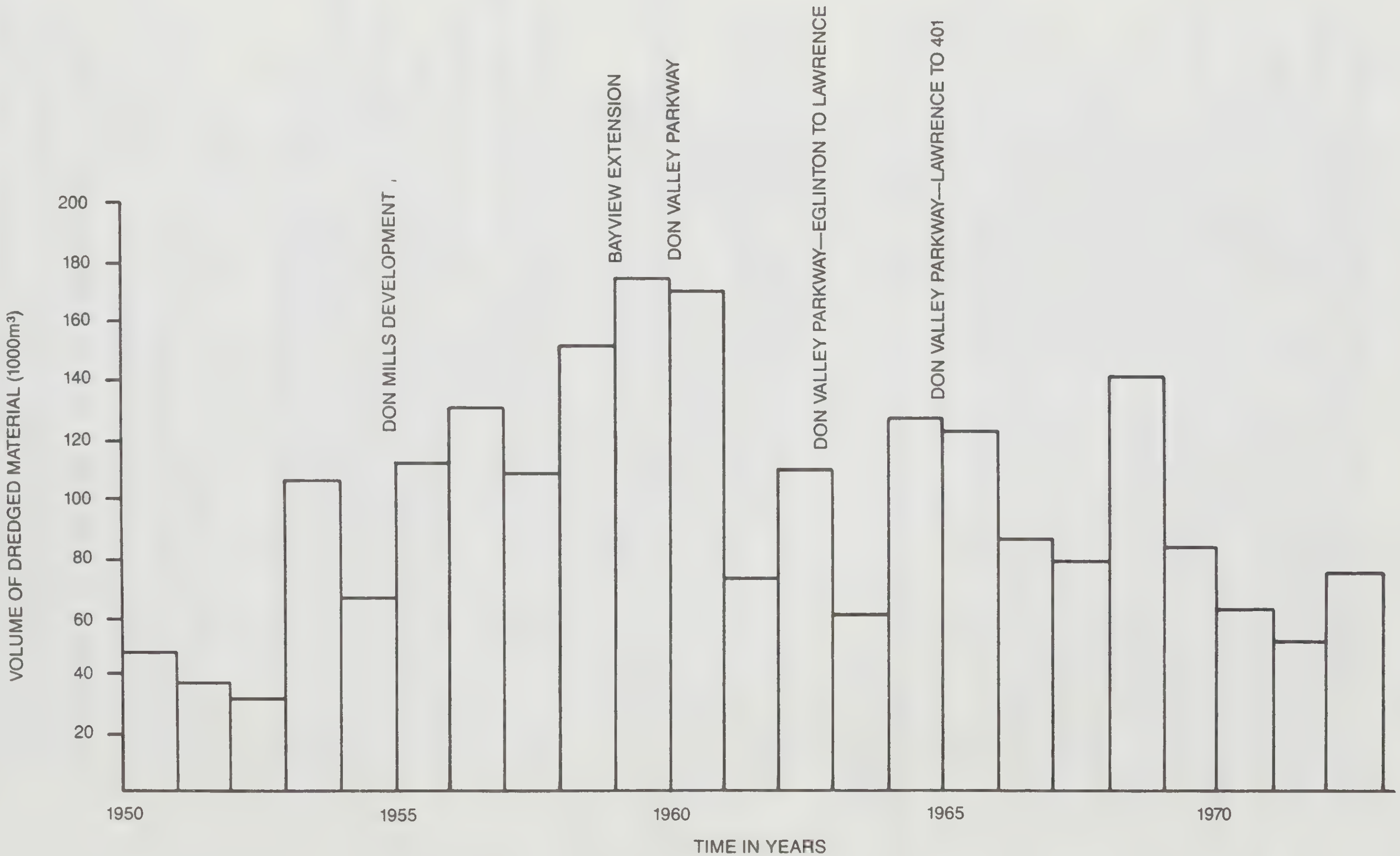



**FIGURE 2.6**
**DREDGING TOTALS FOR KEATING CHANNEL SINCE 1950 (THC 1975)**

Ministry of the Environment
Ontario

There are a number of abandoned landfill sites within the Don River basin, however, there is no evidence that they are contributing to basin contaminant loadings.

## 2.8 Dredging

Dredging in the port of Toronto has been undertaken both by the Public Works Canada (PWC) and the Toronto Harbour Commission (THC). The main shipping channels and harbour area fall under the jurisdiction of the former while the slips and approach channels are the responsibility of the latter. The main harbour channel through the Outer Harbour and the East Gap is presently maintained at a depth of 8.8m, as is the lakeward channel from the West Gap. The main shipping area and the West Gap are maintained at 8.2m.

The Keating Channel was dredged by the THC on an annual basis between 1920 and 1974. Over this period the maximum volume dredged was $173.5 \times 10^3\ m^3$ within the 1960's; the average for the years 1952 to 1972 was approximately $88.5 \times 10^3\ m^3$ (THC, 1975). This material was disposed of in the open lake and in construction of the Eastern Headland.

During 1973 and 1974, the Outer Harbour and East Gap were dredged in order to expand the port facilities and make the East Gap the main harbour entrance, as mentioned in the shoreline modifications section. Approximately $6.5 \times 10^6\ m^3$ of sandy material were hydraulically dredged and used to construct the 66ha Aquatic Park. Since 1975 maintenance dredging for navigation purposes has been undertaken at the northeastern corner of the Inner Harbour (westward from the Cherry Street bridge) and along the waterfront slips. The quantities of material dredged for the years 1975 to 1983 and placed in confined disposal facility are given in Table 2.3.

TABLE 2.3 - Inner Harbour Dredged Volumes

| Year | Volume ($m^3$) |
|---|---|
| 1975 | 44100 |
| 1976 | - |
| 1977 | 3662 |
| 1978 | 13341 |
| 1979 | 3392 |
| 1980 | 43040 |
| 1981 | 102875 |
| 1982 | 73101 |
| 1983 | 28095 |
| Total | 311606 |

(THC, 1983)

## 2.9 Sediment Transport

The primary energy source for nearshore sediment transport in the Great Lakes is wind. Winds that blow over the water generate waves and currents and the greater the distance of open water over which the wind can blow (referred to as fetch) the larger the waves generated. The longest fetch for the Toronto Waterfront is from the east (about 260km).

Wave action is responsible for suspending bottom material into the water column and eroding beach material. The zone of major interest with regard to material movement in the nearshore is the "littoral zone" and the material transported is referred to as "littoral drift". There are three basic ways in which material is moved in the littoral zone. The first is material known as beach-drift which is moved up and down the shoreline in a zigzag fashion with a net forward movement in the direction of the waves. Waves that break at an angle to the shore generate longshore

currents that move material in suspension and as bedload. Finally, in some locations a "rip cell" circulation may be established which generates longshore and offshore currents again transporting material in suspension and as bedload. Generally, the observed transport is a result of the complex interaction of oscillatory flows, due to waves and unidirectional flows.

Although littoral drift may move in different directions depending on the direction of the wave approach, there is a net drift in a given direction over time. In the Toronto area, the net littoral drift is from the east to west. Over the years, this process has resulted in the formation of the Toronto Island from sediment derived from the Scarborough Bluffs (Fricbergs, 1970).

Most studies on littoral transport in the Toronto Waterfront have not considered the effects of the Eastern Headland which now occupies a significant portion of the littoral transport zone. It is, therefore, not clear how the structure might have modified the littoral process in the vicinity of Toronto Island over the last few years. Between the years 1966 and 1969 when the Eastern Headland occupied considerably less of the nearshore zone, it was noted that the structure was impeding currents to the east (Simpson and Rodgers, 1970).

The littoral transport process is very noticeable in that portion of the waterfront east of Toronto Island where eroding bluff material provides a major source of material. It is generally felt that much of the fine material originating from Scarborough Bluff is carried offshore while some of the sandy material is carried as far west as Gibraltar Point on Toronto Island. Some of the sandy material passes Gibraltar Point where it comes under the influence of waves from the southwest. As a result, some material is transported in a northerly direction along the west side of the Toronto Island (Lewis and Sly, 1971).

Further evidence of the westward drift of bluff material can be found on the updrift (eastern) side of structures such as the Bluffers and Ashbridges Bay Lakefill Parks where large quantities of littoral sand have been intercepted. The littoral process is not very evident west of Humber Bay where the stable shoreline does not provide littoral drift material.

Areas of the nearshore subjected to direct wave and current action are normally free of fine-grained material. The sediments in Humber Bay and the small embayments such as Ashbridges Bay and areas in the lee of lakefills are not directly subjected to the forces of the larger easterly waves and the bottom, as a result, consists of a large portion of fine-grained materials such as silts.

The physical and chemical characteristics of the surficial sediments of Humber Bay are influenced by material brought into the Bay by Humber River, Mimico Creek and the STP and storm sewers. Humber Bay has been described as a "bathymetric trap" in which most of the sediments discharged by the various sources remain in the Bay (Lewis and Sly, 1971). Because of the relatively great depths and major influence of southwest waves, much of the material in the Bay are likely to remain there long after they are deposited.

A comparison of recent studies, such as Rukavina (1968) and Lewis and Sly (1971), with a study carried out by Kindle (1925), shows that the physical characteristics and distribution of Humber Bay sediments have changed little over the past 50 years. See Figures 2.7, 2.8 for Rukavina's and Kindle's bottom type maps, respectively.

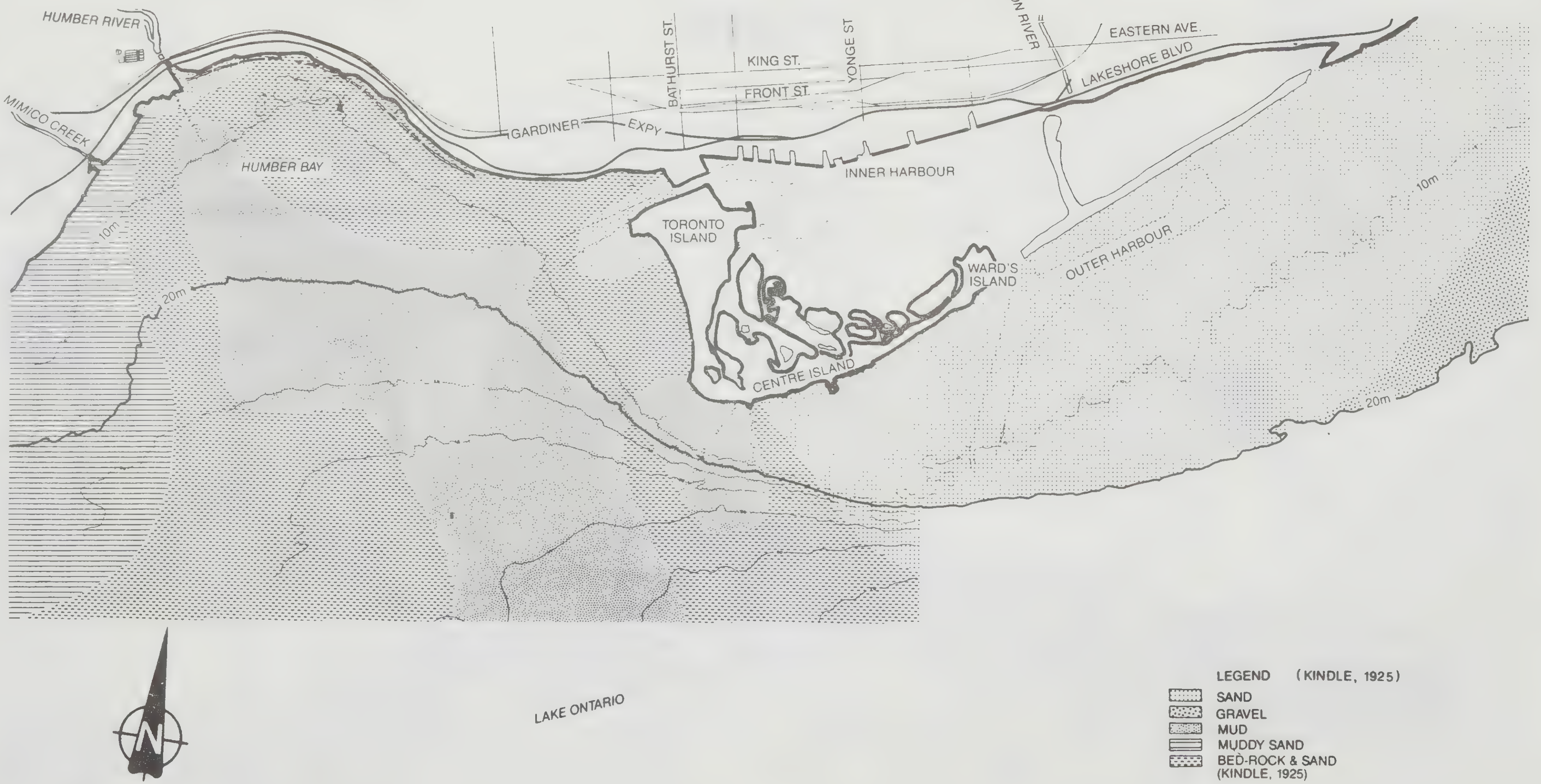
## 2.10 Harbour Circulation

Recent estimates of the dimensions of the Inner Harbour indicate a water surface area of $4.8 \times 10^6\ m^2$, a water volume of $4.1 \times 10^7\ m^3$ and an average depth of 8.5m (MOE, 1978).


**Harbour and shoreline configuration is not indicative of 1968.**

FIGURE 2.7
BOTTOM TYPE

Ontario
Ministry of the Environment




**Harbour and shoreline configuration is not indicative of 1925.**

Ministry of the Environment
Ontario

FIGURE 2.8
BOTTOM TYPE IN 1925

In general, the net circulation in Toronto Harbour is consistently from west to east with a net inflow through the West Gap and a net flow outward through the East Gap (CWPC, 1976 and MOE, 1978). The exchange of water in the Inner Harbour depends primarily on the following:

- inflow and outflow through the West and East Gaps;
- inflow from the Don River;
- inflow from waterfront combined and storm sewer discharges;
- direct precipitation and evaporation;
- withdrawal of cooling water from the Inner Harbour and subsequent discharge into the Outer Harbour by the Hearn Generating Station (located at the eastern end of the Shipping channel) (when plant is in operation).

These components are identified in Figure 2.9. Flow through the gaps will be influenced by various factors including seiches, local winds and ship traffic. Input from the Don River and sewer discharges will reflect the hydrologic characteristics of the area and can be expected to closely follow precipitation events.

Various estimates have been made regarding the net daily exchange of Inner Harbour water employing measurements of the magnitude of flow from the above sources (CWPC, 1976 and MOE, 1978). Indications are that the harbour, in 1975, had a net daily exchange equal to approximately 10% of the Inner Harbour volume, and hence a residence time of about 10 days. Inflow from the Don River was estimated to represent approximately 1% of the Inner Harbour volume while outflow through the Hearn G.S. equalled about 6% of the Inner Harbour volume. The recent reduction in use of the Hearn G.S. may, therefore, have a significant effect on the exchange of Inner Harbour water.

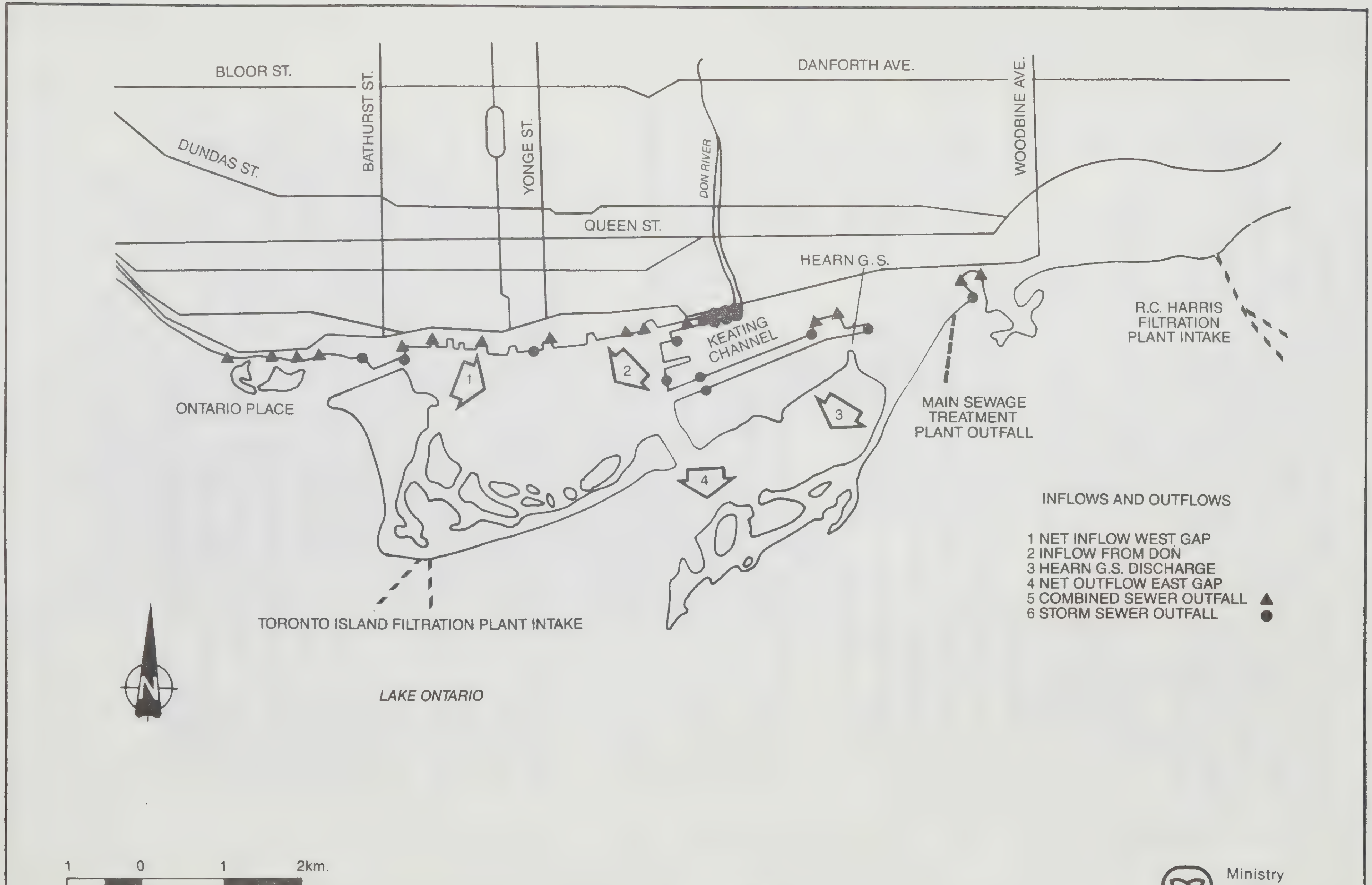



**FIGURE 2.9**
**TORONTO HARBOUR CIRCULATION (MODIFIED FROM CWPC 1976)**

Ministry of the Environment
Ontario

Water quality in the harbour will be a reflection of contaminant levels in the various inflows (i.e. the Don River, combined and storm sewer discharges). The high degree of contamination associated with certain outfalls along the harbour waterfront, particularly the Yonge Street and Simcoe Street slips, is modified by their intermittent flow pattern and small discharge relative to the total harbour volume. As a result, despite fluctuations in Don River water quality, contaminant levels in the Inner Harbour remain relatively stable (MOE, 1977). The limited exchange between the Inner Harbour and the open lake means that water quality is poorest in the Inner Harbour and highest in the open lake, with Outer Harbour quality ranging between the two depending on prevailing winds, nearshore currents and outflow from the Hearn G.S.

## 2.11 Bottom Types Along the Toronto Waterfront

In general, bed material on the Toronto Shelf is composed of sand and silty-sand offshore from the Toronto Island, with a progressively larger fraction of coarse material to the northeast. Silty-clays and muds characterize the bottom between the Toronto Scarp and the Niagara basin, and in the eastern portion of Humber Bay (immediately to the west of the Harbour) while shale bedrock is exposed to the west of Humber Bay (CWPC, 1976).

The most comprehensive survey of the bottom types along the waterfront was carried out by Rukavina (1968) who mapped the distribution of bottom types (Figure 2.7). The first major attempt to characterize the sediment quality along the waterfront was undertaken by Wilkins (MOE 1974). That study found that the characteristics of the surface sediments in the vicinity of lakefilling activities were being modified. Sandy bottoms were covered by silt and clay material.

The nearshore sandy sediments in the area around Toronto Island remained largely unchanged by construction activities, (Wilkins, 1974). Progressing lakeward and roughly from the 30m depth contour where the effects of wave generated currents were less pronounced, fine particles settled to form an "organic clay and silt covering". Humber Bay was characterized by silty sediments except in water depths shallower than 10m where sands predominated. Sediments in the inner portion of Ashbridges Bay were a mixture of heavily contaminated sand, silt and clay, which became progressively cleaner lakewards with clean sand at the lakeward limit of the Bay (Wilkins, 1974).

Wilkins also found the Keating Channel sediment to be progressively worse from the Don River mouth to the Cherry Street bridge, grading from clean sand to organic silty-clay ooze. It was found that contaminants were generally in higher concentration in recent silts and clays than in sand or glacial age clay till (Wilkins, 1974).

## 2.12 Waterfront Use

Aside from the use of its port and terminal facilities, the Toronto Waterfront supports a variety of other uses, most notably water supply, waste disposal and recreation. Several water filtration plants (WFP) draw water from the lake while a number of sewage treatment plants (STP) and storm sewers discharge into the lake (Figure 2.5). Recreational use of the area is intensive and consists chiefly of boating, swimming, and fishing.

Various port and terminal facilities are associated with Toronto Waterfront industries. Bulk terminal facilities in the Port of Toronto are operated by 29 private commercial companies and include grain elevators, coal docks, dry bulk cargo docks (e.g. cement, scrap metal, sand, salt, sugar),

and liquid cargo docks (e.g. calcium chloride, petrochemicals, molasses, vegetable oil). The shipping season averages 250 days from April through mid December (THC, 1980).

Degradation of water quality by industrial effluent is not an apparent problem since all industries within the area discharge their processed effluent to the municipal sanitary collection system. Only cooling water is discharged into the harbour and no significant adverse effects have been discovered (CWPC, 1976). The discharge of contaminants in urban runoff, particularly oil and greases from the railway yards and industrial or commercial areas immediately to the north of the waterfront, does result in localized contaminant loadings to the harbour.

# CHAPTER 3 - SURVEY PROCEDURES

Sediment surveys were carried out along the Toronto Waterfront, including the Toronto Harbour, between 1976 and 1983. A particular section of the Toronto Waterfront was sampled each year to obtain maximum coverage of the Waterfront as it was not practical to complete the entire study in a single season. The procedures outlined below are reported according to the year the study was conducted.

## 3.1 MOE 1976 Sediment Survey

The 1976 survey covered both the Inner Harbour and Outer harbour. Surficial sediment samples were collected with a Shipek grab sampler. Sampling stations were preselected (Figure 3.1) to provide a wide coverage of the study area. The stations (92 stations) were positioned in the field with the aid of marine radar.

Upon obtaining a sample, the top few centimeters (approximately 3cm) were placed in precleaned wide-mouth glass jars. Samples for PCB and pesticide analyses were placed in solvent rinsed glass jars with foil lined lids. Sample jars were then appropriately labelled and stored in a cooler. At the end of each day that samples were collected, they were delivered to the MOE laboratory.

Samples were analyzed for loss on ignition, total phosphorus, total Kjeldahl nitrogen, chromium, copper, mercury, lead, zinc, nickel, oil and grease (Solvent extractables) and PCB's.

## 3.2 MOE 1977 Sediment Survey

In 1977, an effort was made to determine the variation in sediment type and quality relative to sediment depths in the Inner and Outer Harbour. Diver-retrieved cores were taken at 12 locations, Figure 3.2. The cores were taken

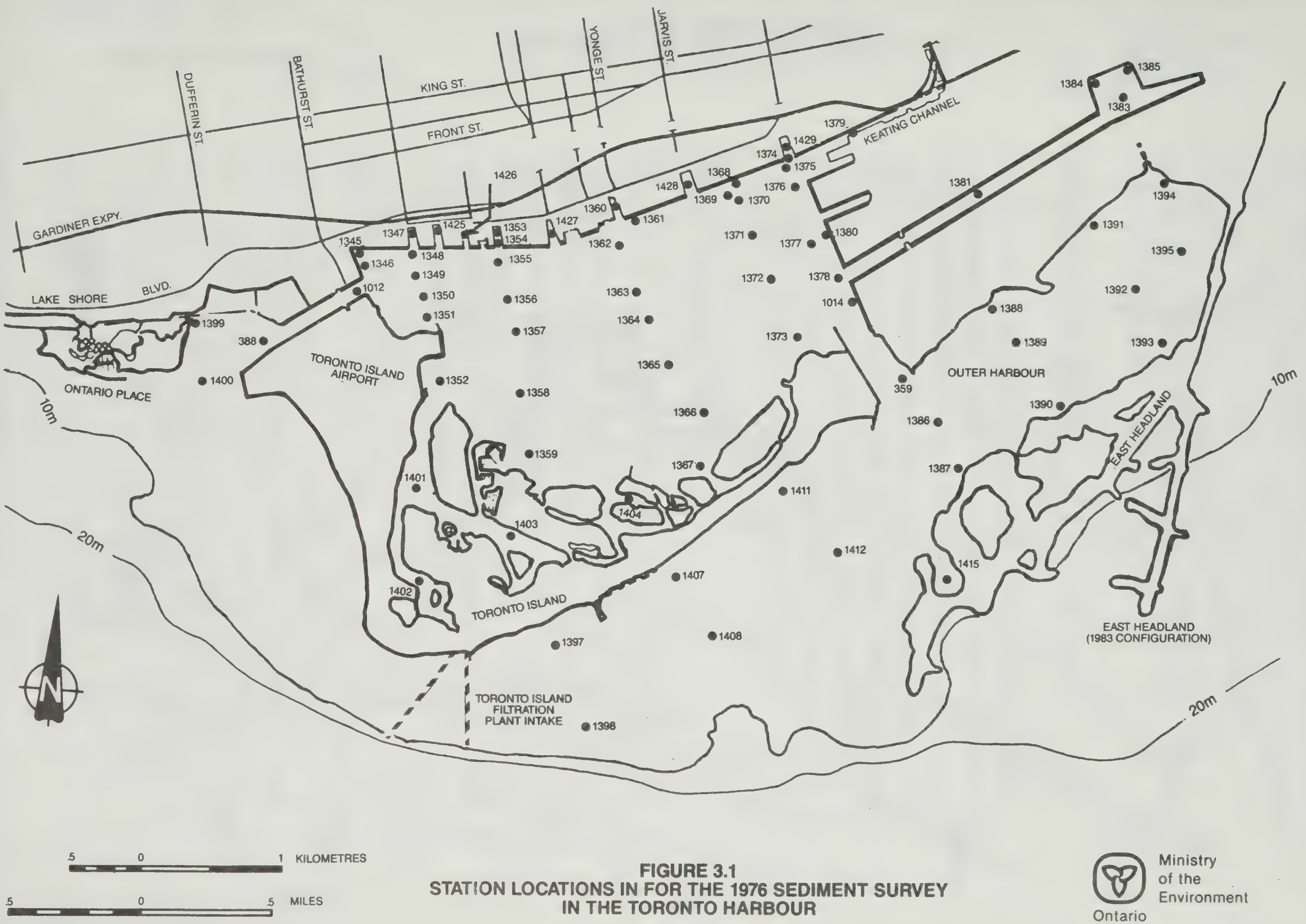



**FIGURE 3.1**
**STATION LOCATIONS IN FOR THE 1976 SEDIMENT SURVEY IN THE TORONTO HARBOUR**


**FIGURE 3.2**
**STATION LOCATIONS FOR THE 1977 SEDIMENT SURVEY**
**IN THE TORONTO HARBOUR**

with plexiglass tubing about 6 cm in diameter and a meter long. The hand-held cores were pushed into the sediment by the diver who then capped the bottom of the core and returned it to the surface. The top 20 cm were later sectioned at 5cm intervals and analyzed for particle size, loss on ignition, mercury, lead and zinc.

## 3.3 MOE 1978 Sediment Survey

In 1978, an extensive survey of the Toronto Island lagoons and waterways was carried out. Diver-retrieved cores were taken at 28 stations around the islands and 8 stations in the area along the waterfront of the harbour (Figure 3.3). The top 5cm of each core was analyzed for particle size, loss on ignition, total phosphorus, total Kjeldahl nitrogen, chromium, copper, mercury, lead, zinc, nickel, oil and grease (solvent extractables), and PCB's.

## 3.4 MOE 1979 Sediment Survey

In 1979, a comprehensive sediment survey of Humber Bay was carried out. Samples were collected with a Shipek grab sampler for 40 stations located in the bay (Figure 3.4). Samples were analyzed for particle size, loss on ignition, total phosphorus, total Kjeldahl nitrogen, chromium, copper, mercury, lead, zinc, cadmium, total organic carbon, oil and grease (solvent extractables) and PCB's.

## 3.5 MOE 1980 Sediment Survey

The Keating Channel was surveyed in 1980 (Figure 3.5). Diver-retrieved core samples were taken at 8 stations and the top 10cm were analyzed for particle size, loss on ignition, total phosphorus, total Kjeldahl nitrogen, chromium, copper, mercury, lead, zinc, iron, aluminum, nickel, oil and grease (solvent extractables) and PCB's.

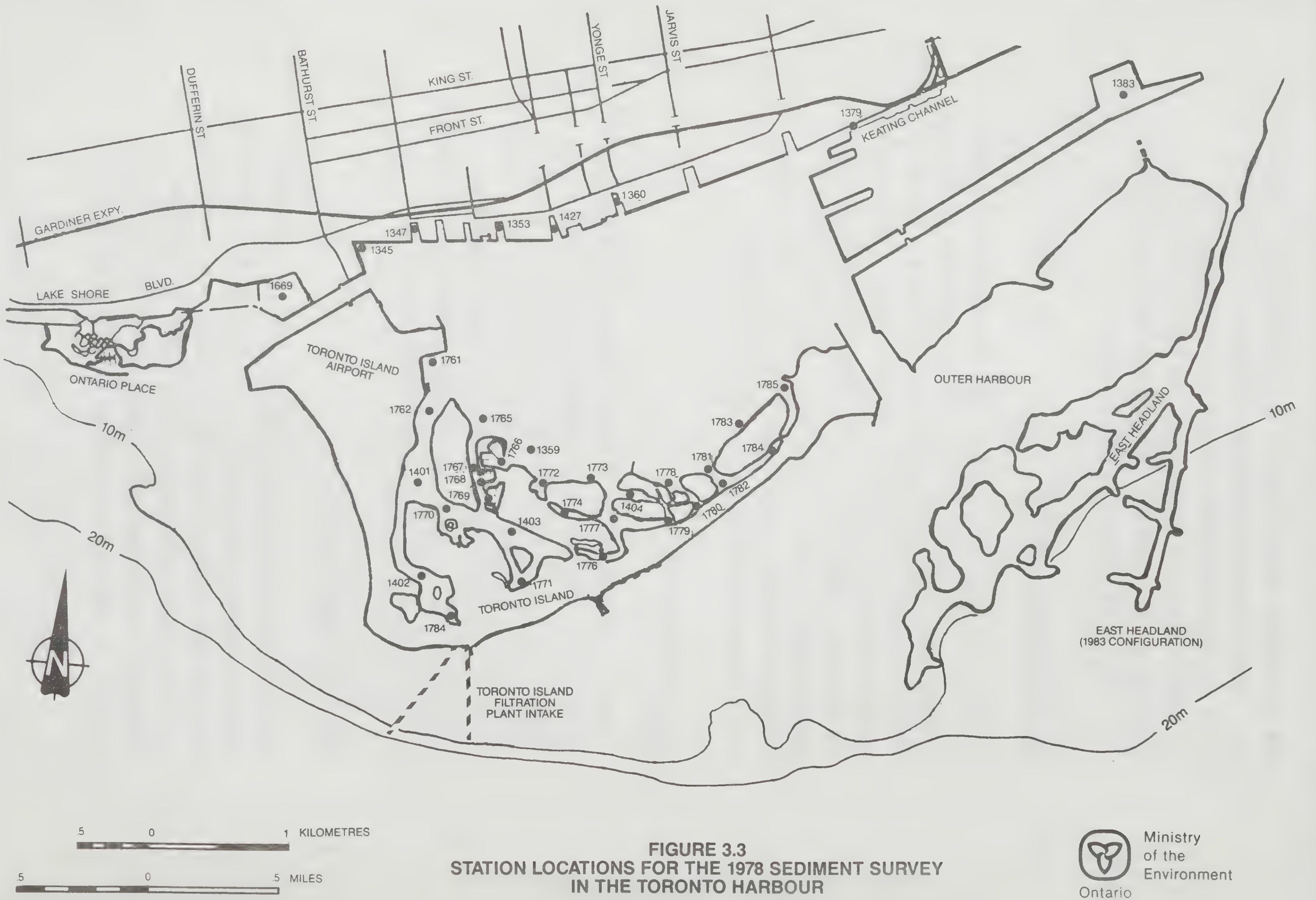



**FIGURE 3.3**
**STATION LOCATIONS FOR THE 1978 SEDIMENT SURVEY IN THE TORONTO HARBOUR**

Ministry of the Environment
Ontario

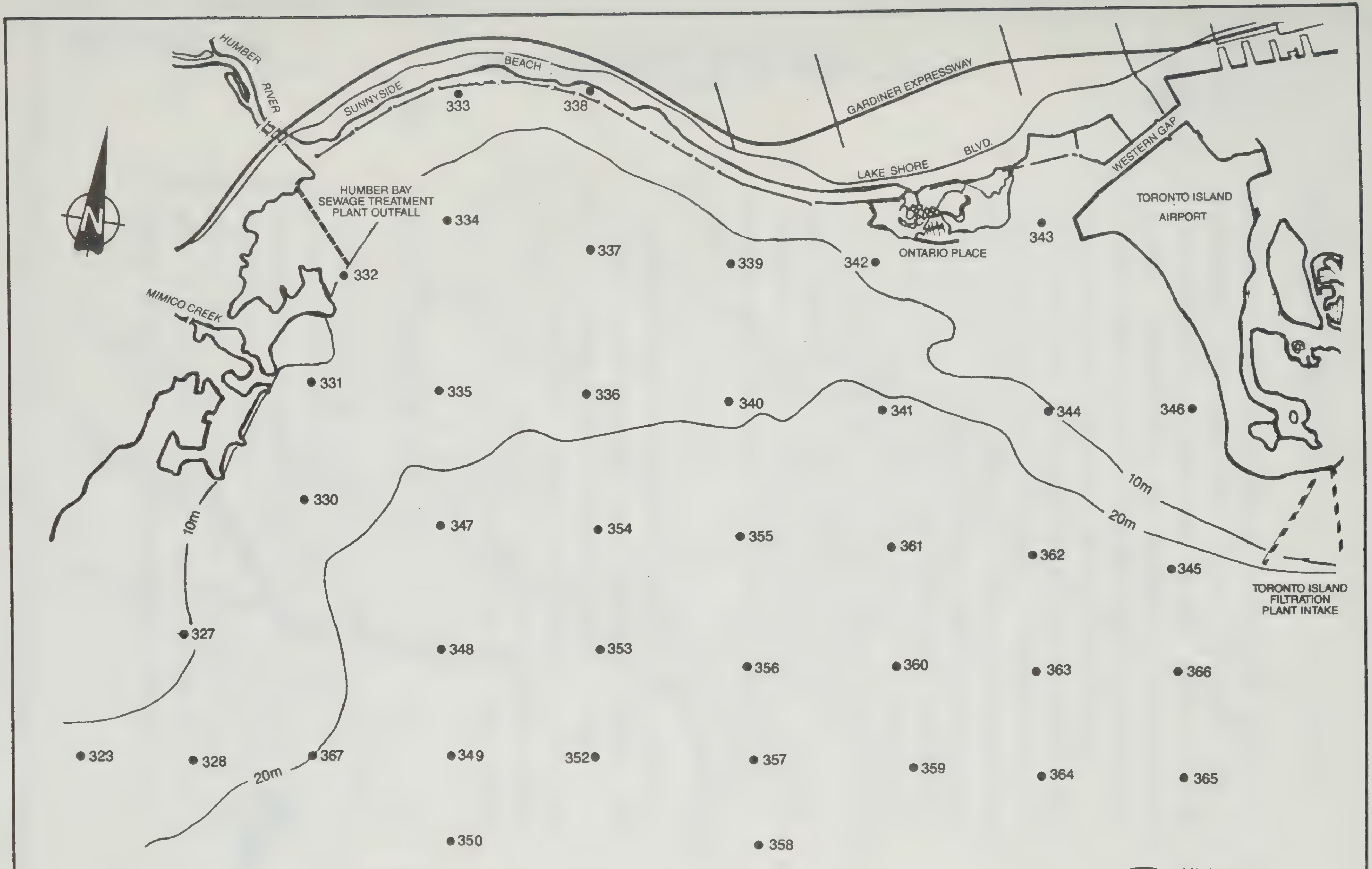



FIGURE 3.4
STATION LOCATIONS FOR THE 1979 SEDIMENT SURVEY
IN THE HUMBER BAY

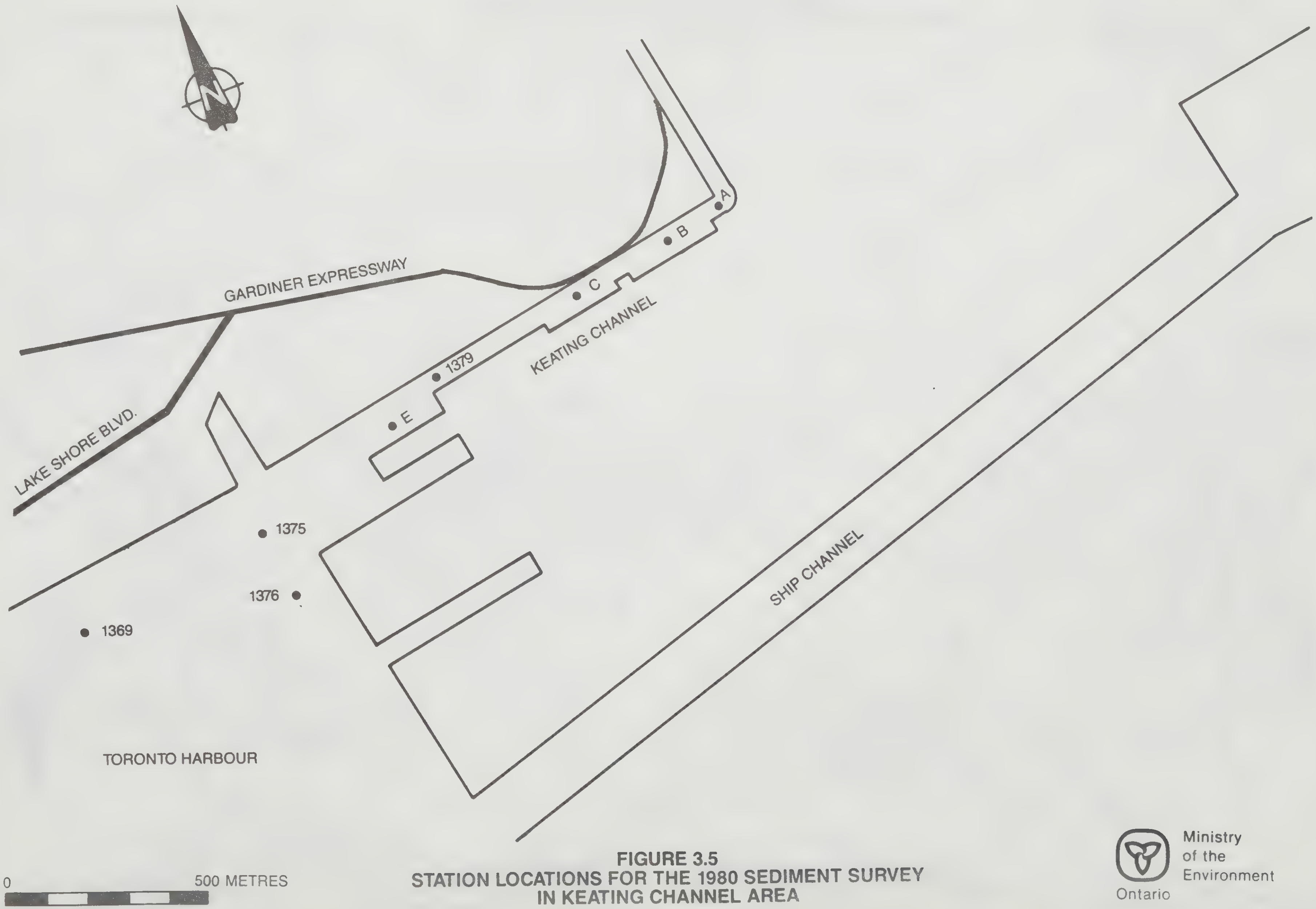



FIGURE 3.5
STATION LOCATIONS FOR THE 1980 SEDIMENT SURVEY
IN KEATING CHANNEL AREA

Ministry of the Environment
Ontario

## 3.6 MOE 1982 Sediment Survey

In 1982, an extensive survey was carried out covering the entire Waterfront from Highland Creek in the east to Etobicoke Creek in the west and lakeward to the 20m depth contour. The purpose of the study was to determine whether any significant changes in sediment quality had occurred along the Toronto Waterfront since the 1976 survey. Twenty-five surficial samples were collected with a Shipek grab sampler (stations 2111-2135). In addition to the extensive survey, an intensive diver reconnaissance survey was conducted. The stations(144) sampled were located between the Toronto Island Filtration Plant and the R.C. Harris Filtration Plant. The divers were instructed to collect roughly the top 3cm of sediment by pressing a wide mouth glass jar into the sediment and capping it underwater. A visual description of the lake bottom at each station of the diver survey was provided. (See Appendix A).

The sediments were analyzed for particle size, loss on ignition, total phosphorus, total Kjeldahl nitrogen, total organic carbon, arsenic, cadmium, chromium, copper, mercury, lead, zinc, solvent extractables (oil and grease) and PCB's. See Figures 3.6A, B, C, for station locations for the extensive survey and the intensive diver survey.

## 3.7 MOE 1983 Sediment Survey

Sediment samples were collected behind the Humber Bay breakwall with an Ekman grab sampler in 1983. Fifteen stations were sampled between the Humber River mouth and the Boulevard Club (Figure 3.7). The analyses consisted of particle size, total phosphorus, total Kjeldahl nitrogen, total organic carbon, loss on ignition, cadmium, chromium, copper, lead, zinc, solvent extractables and PCB's.

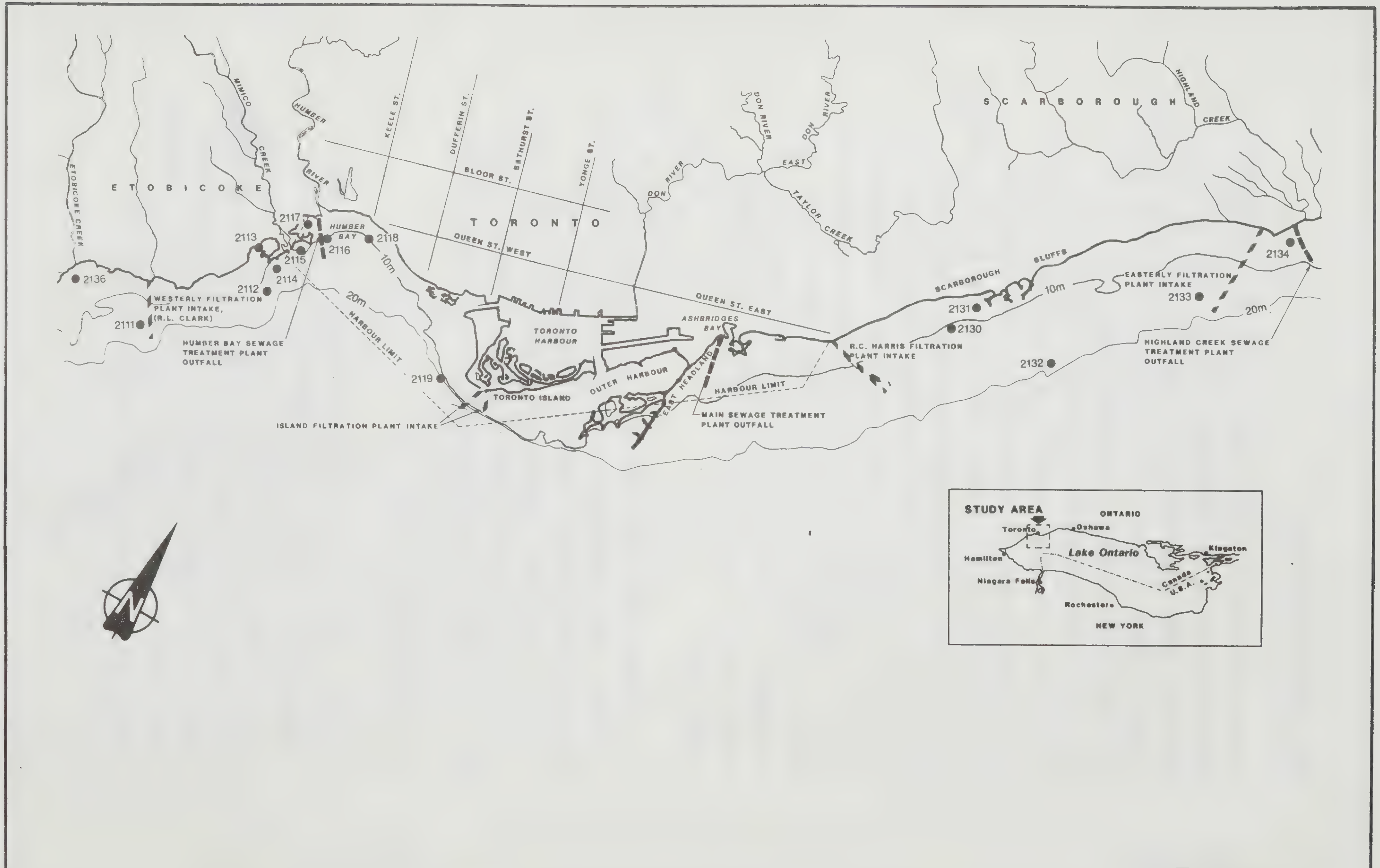



**FIGURE 3.6A**
STATION LOCATIONS FOR THE 1982 SEDIMENT SURVEY
ALONG TORONTO WATERFRONT (PART OF EXTENSIVE SURVEY)

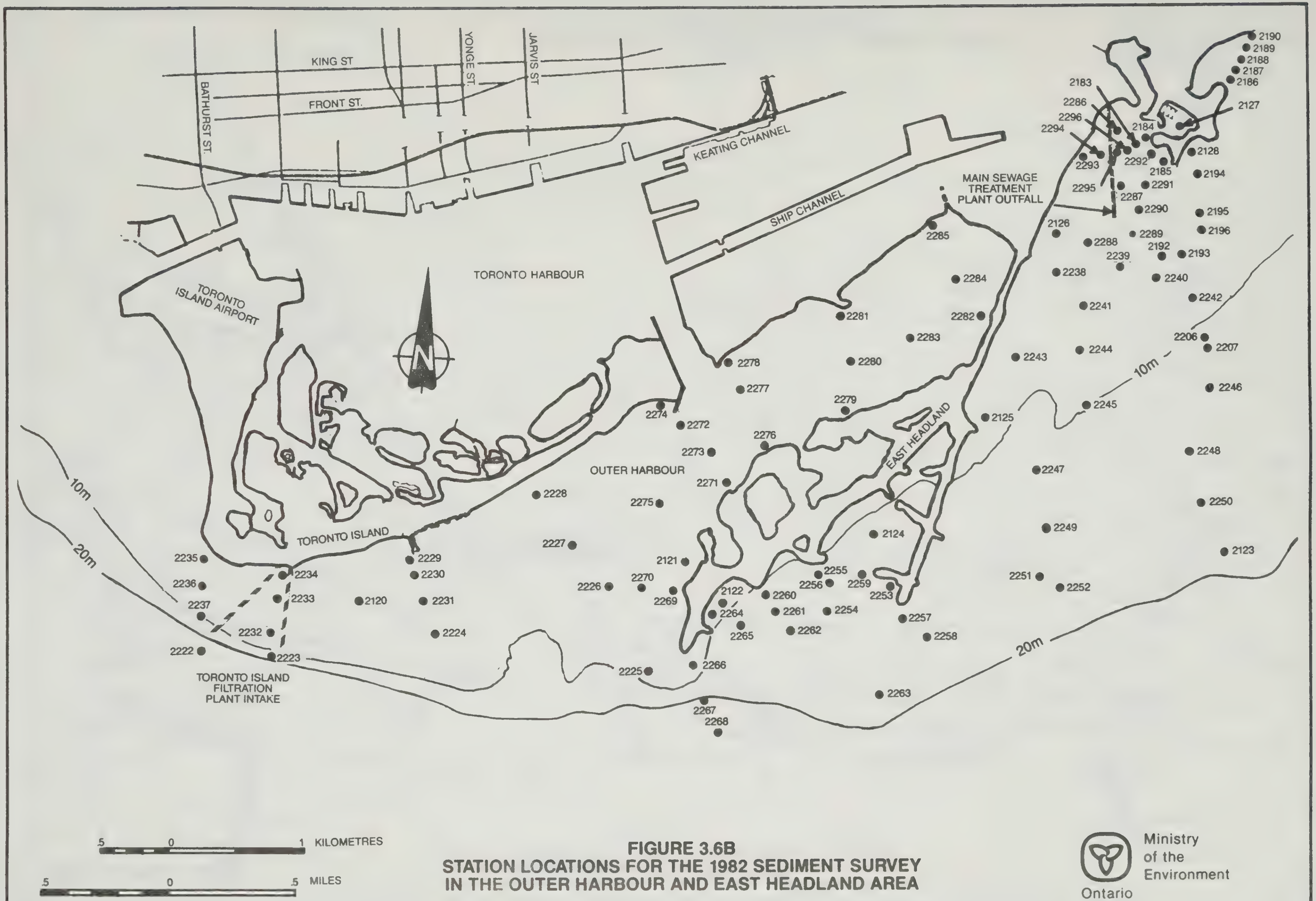



**FIGURE 3.6B**
**STATION LOCATIONS FOR THE 1982 SEDIMENT SURVEY IN THE OUTER HARBOUR AND EAST HEADLAND AREA**

Ministry of the Environment
Ontario

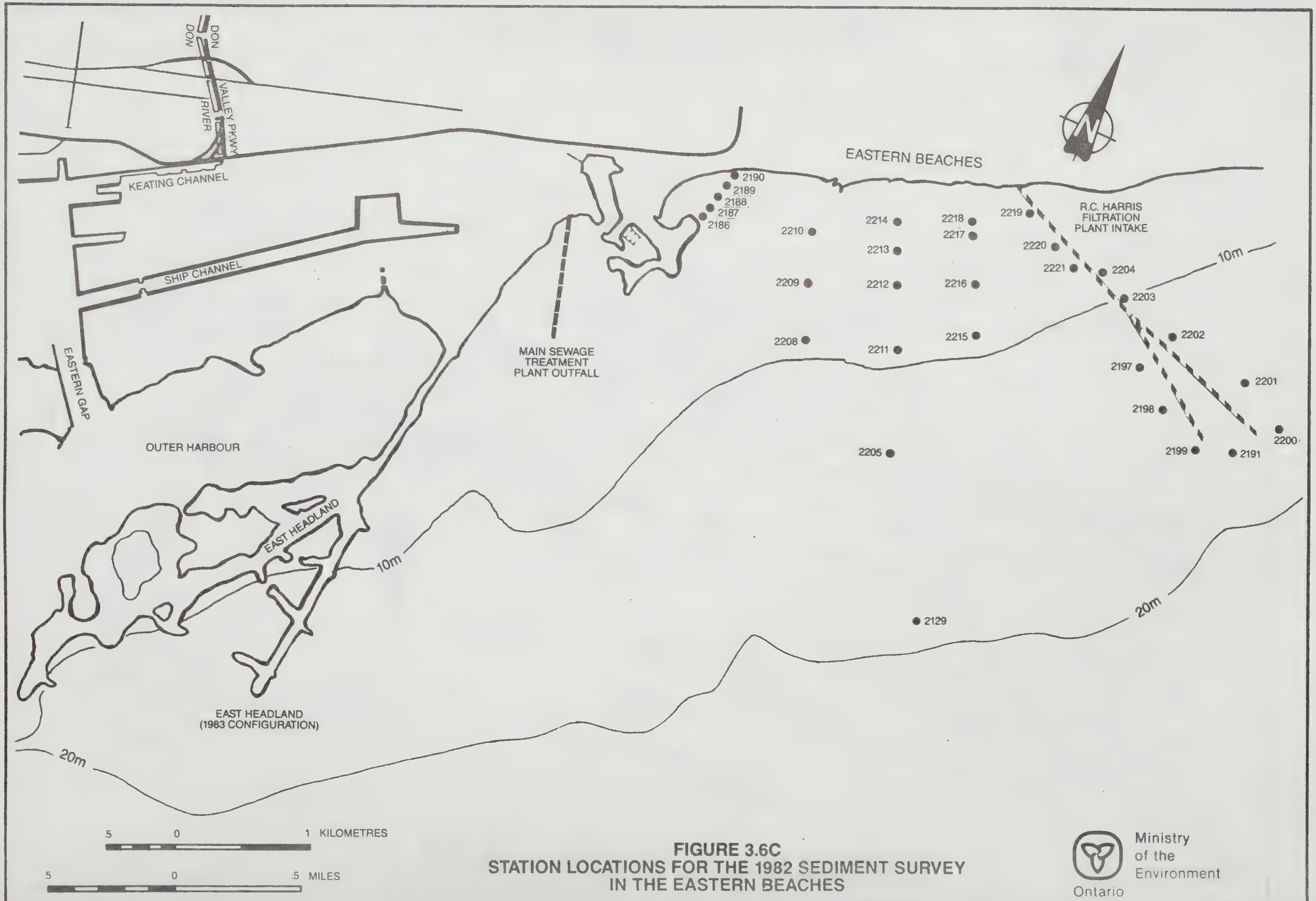



**FIGURE 3.6C**
**STATION LOCATIONS FOR THE 1982 SEDIMENT SURVEY IN THE EASTERN BEACHES**

Ministry of the Environment
Ontario

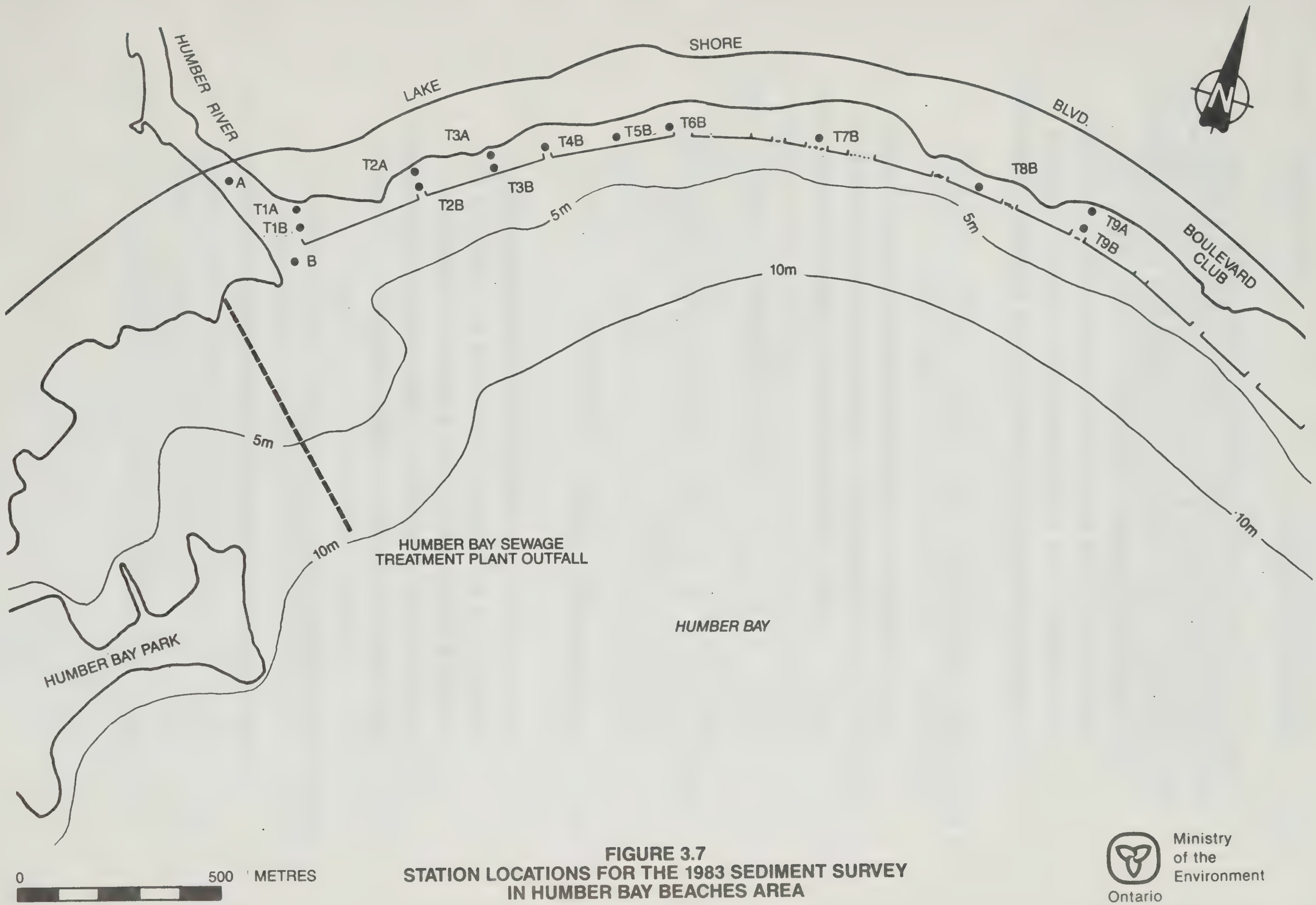



**FIGURE 3.7**
**STATION LOCATIONS FOR THE 1983 SEDIMENT SURVEY IN HUMBER BAY BEACHES AREA**

Ministry of the Environment
Ontario

## 3.8 Laboratory Procedures

Analyses of the samples for the seven sediment surveys described earlier were carried out by the MOE's laboratory according to the MOE standards documented in the Outlines of Analytical Methods (MOE 1981). All parameters are expressed on a dry weight basis unless stated otherwise. The following is a brief description of the laboratory procedures employed by the MOE for the parameters studied.

### 3.8(1) Particle Size (%)

Several methods are used when determining particle size. Sieving is carried out to separate the sand fraction and coarser material. The hydrometer is used to differentiate between the silt and clay fractions by measuring changes in density of a suspension in a sedimentation cylinder. The hydrometer works on the principle of Stokes Law - density changes can be related to the settling velocity of the particles (MOE, 1981).

### 3.8(2) Total Phosphorus (mg/g)

All phosphorus is converted to the inorganic form by digestion in hot sulphuric acid and the addition of potassium persulphate. The parameter is measured colorimetrically, using the ammonium molybdate-ascorbic acid Auto Analyzer method (MOE, 1981).

### 3.8(3) Total Kjeldahl Nitrogen (mg/g)

The sample is pretreated by digesting with sulphuric acid, mercuric oxide and potassium sulphate. Analysis is conducted colorimetrically using the alkaline phenol hypochlorite method adapted to an Auto Analyzer (MOE, 1981).

3.8(4) Metals (ug/g)

The procedure used in determining metal concentrations is a total digestion. Samples are digested in a 1:3 mixture of nitric acid to hydrochloric acid on a hot plate overnight. Analysis is by atomic spectroscopy (ICAP or AAS) (MOE, 1981).

3.8(5) PCB's (ng/g)

Samples are dried, concentrated and the analysis is carried out by electron capture gas chromatography. To determine the concentration of the PCB's separately from organochloride pesticides, the sediment sample undergoes Florisil column chromatography(MOE, 1981).

3.8(6) Solvent Extractables (ug/g)

The test is often referred to as oil and grease. Selected solvents are used to extract the organic extractable material. Identification of the organic compounds is carried out by chromatography(MOE, 1983).

3.8(7) Total Organic Carbon(TOC)(mg/g)

TOC is detetermined by first analyzing for total and inorganic carbon. The difference between the two values gives TOC. The total carbon value is obtained by producing carbon dioxide in a high temperature combustion tube . Inorganic carbon is measured by producing carbon dioxide in a low temperature acid decomposition tube. Both are measured in the non-dispersive infra-red analyzer(MOE, 1983).

3.8(8) Loss on Ignition(%)

The samples are ignited at 600$^{o}$C for one hour. Loss on ignition can be defined as oxidation of carbon and hydrogen, the escape of water of hydration, volatilization of inorganic ammonium salts, decomposition of magnesium carbonates and the loss of other materials which are volatile or decomposable below 600$^{o}$C(MOE, 1981).

# CHAPTER 4 - RESULTS

The sediment data obtained during the various surveys along the Toronto Waterfront are presented on the following pages in the form of tables and contoured maps. The results are arranged according to the following areas:

- Humber Bay to Etobicoke Creek
- Toronto Island and Eastern Headland
- Toronto Harbour
- Eastern Beaches to Highland Creek

Within these areas the results are presented according to the year in which the surveys were carried out.

A Synagraphic - mapping program (SYMAP - computer mapping program), (Dougenik and Sheehan, 1976) was used to contour the concentrations of the parameters measured. The contour maps display data by interpolating a continuous surface based on distance and the values of the neighbouring data points.

The MOE numerical Guideline for Open Water Disposal of Dredged material is noted for each of the parameters mapped. The guideline is used as an indicator of the degree of chemical contamination, and parameter values in excess of the guidelines do not necessary imply that the parameter will have biological or water quality impacts. An interim guideline of 10mg/g for total organic carbon applies to the nearshore area of Lake Ontario.

As a convenient guide, the following scheme can be used to categorize the data.

- Sediment with parameter values less than the respective MOE guideline can be considered clean;
- Values above the guidelines can be considered contaminated;
- Values in excess of two times the guidelines are highly contaminated.

## 4.1 Humber Bay to Etobicoke Creek

### 4.1A 1979 Sediment Survey (see Table A.1 in the Appendix)

In 1979, the characteristic sediment type found in Humber Bay was fine material such as silts and clays (Figure A.1-1). This material was found mainly in the central portion of the bay, especially around the Main Sewage Treatment Plant (STP) outfall. A strip of coarse material, i.e. sand, was identified along the shoreline on the west side of Toronto Island and continuing over to Sunnyside Beach.

There appears to be the characteristic association between sediment type and quality in the area. The fine material around the Humber STP (e.g. at stations: 330, 331, 332, 334, 335, 330, 347, 336, 337) was contaminated based on loss on ignition, nutrients, metals, solvent extractables and PCB's. In contrast, the coarse sediment at stations close to shore (e.g. 333, 338, 339, 343, 344) and in the western part of the bay (e.g. 327, 328) was clean. See Figures A.1-2 to A.1-13 for sediment quality in Humber Bay. The inner portions of the bay were contaminated and the sediments around the STP were greatly contaminated. A gradual increase in contamination was observed from the shore in a lakeward direction to the 20 meter depth contour. Pockets of highly contaminated sediments existed in the central areas of the Bay (e.g. 358) as shown on the contour maps.

### 4.1B 1982 Sediment Survey (see Table A.2 in the Appendix)

The 1982 sediment survey concentrated on the inner portions of Humber Bay. The results showed a similar distribution as the 1979 survey of predominantly fine sediments (see results for Stations 2114, 2116, 2117, 2118, 2119 in Table A.2 and Figure A.1-14). (Station locations are shown in Figure 3.6A). These stations showed levels of nutrients, metals, solvent extractables and PCB's comparable to the 1979 survey.

The only two stations in Humber Bay with sandy sediments, were 2113 and 2115 and these were located close to the lakefill which means that the sediment might have been material from the toe of the structure. Station 2115 may also be influenced by material from Mimico Creek. The sediment at these two stations was, however, contaminated with elevated levels of metals, and solvent extractables (see Table A.2 in the Appendix).

The sediment at two stations sampled near the mouth of Etobicoke Creek (2135, 2111) was a mixture of sand, silt and clay. Sediment at station 2135 (nearest to the creek of the two stations), had high levels of nutrients, metals and oil and grease. These levels were comparable to the less contaminated sediments in Humber Bay. The sediment from station 2111 was low in nutrients but had elevated levels of metals and oil and grease.

4.1C 1983 Sediment Survey (see Table A.3 in the Appendix)

In 1983, sediment samples were collected from behind the Humber Bay breakwall. The sediment at stations nearest the Humber River (e.g. Stations Humber A, B, T1A, T1B) and at stations closer to the Boulevard Club (e.g. Stations T7B, T9A, T9B) was comprised mainly of clean sands (Figure A.1-15).

The sediments at the remaining stations between the Humber River and Boulevard Club were mainly silt with small amounts of sand and clay. These sediments had elevated levels of phosphorus, cadmium, copper, chromium, lead, zinc, oil and grease and PCB's.

## 4.2 Toronto Island and Eastern Headland (see Table A.4 in the Appendix)

In 1982, the stations sampled along the Toronto Island and south and east of the Eastern Headland consisted mainly of sand (Figure A.2-1). Fine silty material was observed in the deeper portions of the Outer Harbour, in the second cell of the Eastern Headland containment facility and in pockets along the east side of the Eastern Headland.

The sediment type in the study area had a significant bearing on sediment quality in that, the sandy material was relatively uncontaminated while the silty material showed moderate degrees of contamination (Figures A.2-2 to A.2-13). The Outer Harbour sediments were contaminated with respect to phosphorus, metals (except mercury), solvent extractables and PCB's at stations 2277, 2280, 2283 and 2284. Stations 2242, 2260, 2259, 2254 and 2192, close to the headland, also had elevated levels of these parameters. Contaminated levels of mercury was observed at stations 2127 in Ashbridges Bay and at 2259 and 2254 at the Eastern Headland.

Sediments in the areas south of the Toronto Island, east of the headland towards the 20m depth contour and along the shoreline of the Outer Harbour were relatively clean.

## 4.3 Toronto Harbour

### 4.3A 1976 Sediment Survey (see Table A.5 in the Appendix)

During the 1976 sediment survey, both the Inner and Outer Harbour were sampled. The results showed the sediment to have varying degrees of contamination (Figures A.3-2 to A.3-12).

The Inner Harbour sediments showed high levels for loss on ignition, nutrients, metals, solvent extractables and PCB's in the slips and throughout the waterways between the islands. The Keating Channel (located at the mouth of the Don River) sediments showed slightly contaminated levels of phosphorus and some metals such as copper, chromium, lead, nickel and zinc.

The Outer Harbour sediments were contaminated with some metals.(some of the 1976 sediment stations are now covered by the Aquatic Park Area of the Eastern Headland).

Stations near the shore (e.g. 1388, 1391, 1411, 1387, 1390, 1391, 1393) and station 1412 in the approach channel, showed very low levels of metals. The other stations in the middle of the approach channel (e.g. 1386, 1389, 1392, 1395) showed elevated levels of metals except for mercury which was below the MOE Guideline. In general, the sediment in the Inner Harbour was contaminated to a greater extent when compared to the Outer Harbour.

4.3B 1977 Sediment Survey (see Table A.6 in the Appendix)

The sediments in the Inner Harbour (e.g. 1360, 1364, 1366, 1383, 1379, 1403) were mainly fine material which greatly exceeded the MOE Guidelines for loss on ignition, mercury, lead and zinc (Figure 3.1). The Outer Harbour sediments (e.g. 1393, 1394, 202, 1417) were clean, coarse material. Stations off the Toronto Island (e.g. 1536, 1539) consisted of fine but uncontaminated sediments. The results obtained were similar to the extensive 1976 Toronto Harbour survey in that the Inner Harbour sediments consisted of fine, highly contaminated material while the Outer Harbour sediments were coarser and cleaner.

4.3C 1978 Sediment Survey (see Table A.7 in the Appendix)

The sediment quality varied considerably among stations. High levels of total Kjeldahl nitrogen, metals, solvent extractables and PCB's were noted at some stations. Generally, the slips were highly contaminated for all the parameters measured. Those stations in the waterways between the islands showed moderate degrees of contamination.

4.3D 1980 Sediment Survey (see Table A.8 in the Appendix)

The 1980 survey covered the Keating Channel. The sediment consisted of clean, sandy material at the stations nearest the Don River (e.g. 1379, A, B, C) (Figure A.3-13). The stations close to the harbour (e.g. E, 1375, 1376, 1369) consisted of fine, silty sediments with levels of phosphorus, chromium, copper, lead, zinc, iron, solvent extractables and PCB's that slightly exceeded the MOE Guidelines.

4.4 Eastern Beaches-1982 (see Table A.9 in the Appendix)

The sediment along the eastern beaches sector was coarse sandy material which was found to be relatively clean at all stations (Figure A.4). Exceedingly small elevations in phosphorus levels over the MOE guideline were noted at a few stations. These isolated pockets are most likely temporary deposits that reflect the influence of the Main STP discharge in this area. Elevated levels in solvent extractables at stations 2197, 2210, 2212, 2220 and arsenic at station 2200 were also noted. These stations are suspected to be in depressions where localized deposition occurs.

Sampling was also conducted near Scarborough Bluffs and Highland Creek. The Scarborough Bluff stations consisted of coarse, clean, sandy sediments. The sediment station located at the mouth of Highland Creek was slightly contaminated with solvent extractables(oil and grease).

(Because the sediment within the Eastern Beaches - Highland Creek sector is relatively clean, the parameter values are not mapped.)

# CHAPTER 5 - DISCUSSION

## 5.1 Humber Bay

There do not appear to be any marked changes over time in sediment type or quality in Humber Bay based on MOE Survey results between 1979 and 1982.

The surficial sediment in the deeper, central portions of the bay consist primarily of fine material with coarser material near the shoreline of the bay. The portion of Humber Bay bordering on Toronto Island consists of clean sands which form a narrow band that extends northward to a point immediately west of Ontario Place. As suggested by Lewis and Sly (1971), these sands were probably derived from littoral drift material originating at Scarborough Bluffs, and transported as far west as Gibraltar Point on Toronto Island. Some of this material which passes the point is no longer under the direct influence of currents from the east but are subjected to waves and currents from the southwest which move the material northwards.

Sediment quality distribution in Humber Bay appears to correspond to the sediment type distribution. The coarser material around the shoreline of the bay is relatively clean. Progressing inwards to the bay the degree of contamination increases uniformly to a point roughly 2 km south of the Humber STP outfall. From this point to the Humber River mouth and about 1.5 km on either side of the STP discharge pipe is a zone of heavily contaminated sediments. Three zones depicting the sediment quality distribution in Humber Bay are delineated in Figure 5.1.

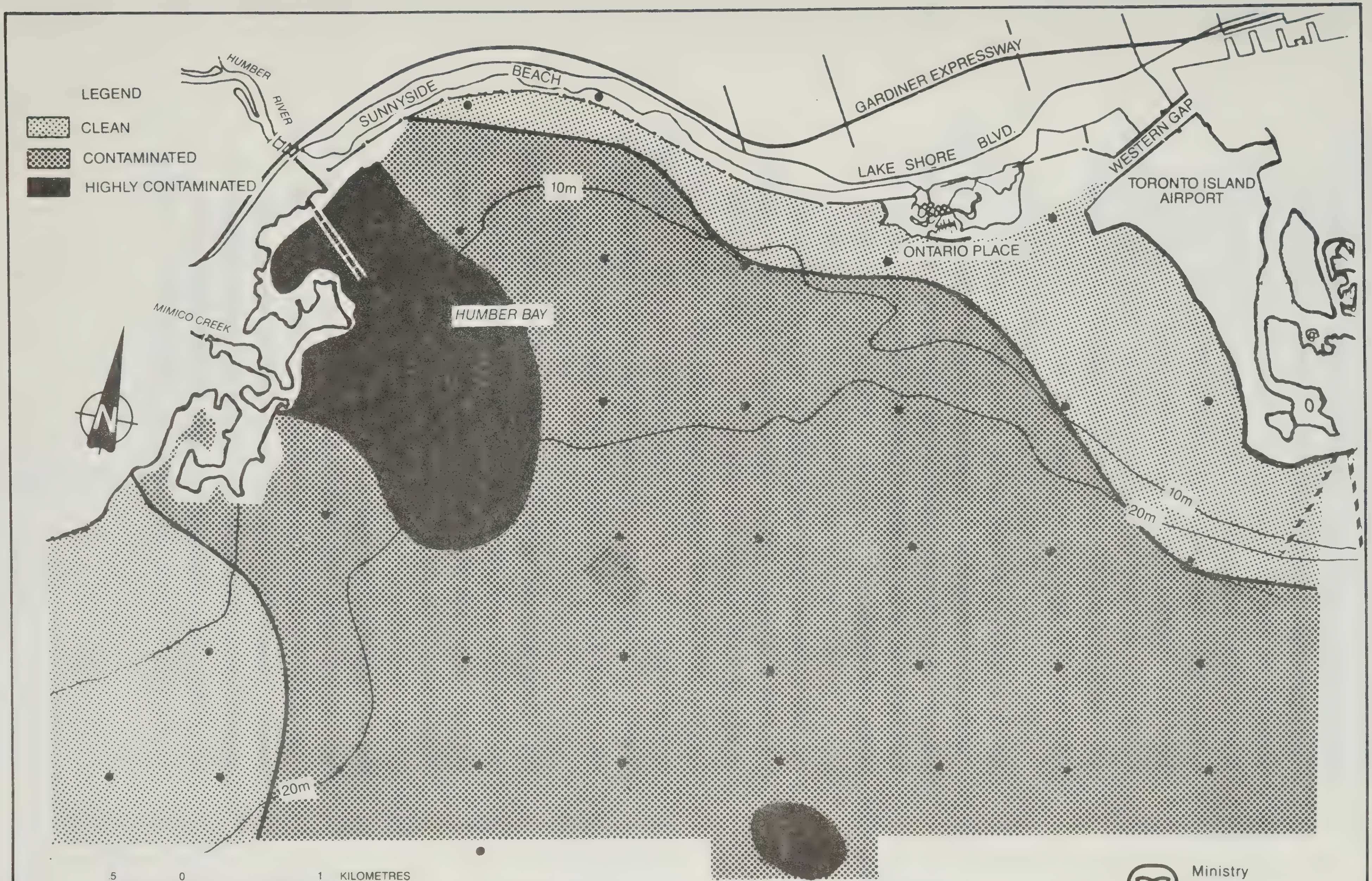



**FIGURE 5.1**
**SEDIMENT QUALITY ZONES WITHIN HUMBER BAY, 1979 SURVEY**

The quality of the sediment inside the Humber Bay breakwall varies across the area sampled. The material at those stations close to the Humber River mouth and in the vicinity of the Boulevard Club (Figure 3.7) consisted of coarse, clean sediments. The sediments at stations in between these two areas had a range of poorer quality material. Deposition of coarse material by the Humber River has resulted in the formation of 'sand bars' between the shoreline and the western terminus of the breakwater (Stations T1A and T1B of Figure 3.7).

The poor quality of sediments along the central portion inside the breakwater is perhaps a reflection of inadequate dispersion of contaminants and/or contaminated sediments entering the area from outside the breakwater or urban storm discharges.

The two stations that were sampled in the Humber Bay lakefill embayment (2113, 2117, Figure 2.1) had elevated levels of the parameters measured. The sediments at Station 2117 in the eastern embayment were highly contaminated. This is not unexpected since this embayment likely traps material from the Humber River discharges and Humber Bay Sewage Treatment Plant discharge.

The likely sources of sediment and contaminants in Humber Bay include the Humber River and the Humber STP with smaller contributions from Mimico Creek and storm sewers discharging into this area.

The relatively great depths, large volume and sheltering from direct main lake circulation distinguishes Humber Bay from other Toronto nearshore areas in the vicinity of river mouths. These features are also responsible for the deposition of fine material in the bay. Discharges into Humber Bay lose momentum and settle throughout the bay. The main lake circulation appears to have some influence on

the surface waters of Humber Bay based on the limited Ministry of the Environment aerial surveillance data. Information on the circulation patterns within the Bay is currently unavailable and it is also not clear whether wave action contributes significantly to resuspension of bottom material. Information on possible contribution of the main STP discharge and Eastern Headland lakefilling to the contamination of Humber Bay sediments is also unavailable and warrants investigation.

## 5.2 Toronto Island and Eastern Headland

The sediment south of the Toronto Island is mainly coarse, clean material. Much of this material was derived from littoral drift originating from the Scarborough Bluffs. The exception to the otherwise clean area is Station 2222 (Figure 3.6B) which scuba divers noted was in a local depression. Fine sediments with elevated levels of various contaminants appear to be trapped in this depression.

The sediments around the Eastern Headland vary in physical type and chemical quality. The area south of the headland is moderately contaminated and in the area immediately east of the headland, the sediments at some stations are clean, while others show slight elevations in contaminant levels. The station in Ashbridges Bay lakefill embayment (2127, Figure 3.6B) is notably more contaminated than adjacent stations.

The major source of contaminants in this area is the Main STP. The material from the STP outfall may be carried in an easterly or westerly direction, depending on current direction. It appears that very little of this discharge is deposited in the vicinity of the outfall, as shown by the low parameter values in the sediment at the stations around the STP outfall. The sediments at stations near the

headland appears to be influenced by material from lakefilling activity at the headland. However, the contribution from this source cannot be clearly defined from the information currently available. Data from current studies using sediment traps may provide clarification in this regard.

## 5.3 Toronto Harbour

In Toronto Inner Harbour, distinct zones (namely slips, Island Waterways, main Harbour and Keating Channel) varying in degree of pollution can be identified. Generally, the harbour sediments consist of fine material, that are greatly contaminated with most of the parameters measured. The most highly contaminated material in the Harbour is found in the slips along the north shore, followed by sediments within the Toronto Island waterways. The main harbour sediments are less contaminated than the slips. In the Keating Channel, the sediments vary from coarse material near the Don River mouth to fine material at the lower end (west) of the channel. The chemical quality of the sediment also becomes progressively worse from east to west in Keating Channel, but in general is much better than the rest of the Inner Harbour.

The sediments in the deeper portions of the Outer Harbour (Shipping Channel) consist of fine contaminated material possibly originating from the Inner Harbour and adjacent lakefilling activity. Outside of the Channel, the sediment is coarse and clean. The distribution pattern of contaminants and the degree of pollution in Toronto Harbour did not show any marked changes between 1976 and 1982.

The sediment and contaminant sources for the Inner Toronto Harbour include storm and combined sewers located within the slips and the Don River. Fine material from the Don River is carried through the Keating Channel into the harbour while the clean, coarser material settle out in the upper Keating Channel. Localized contamination from the storm sewers occurs in the slips of the harbour. The main harbour area is influenced by both the Don River and the storm sewers.

## 5.4 Eastern Beaches

The results from the study have shown that the area encompassing the Eastern Beaches (Ashbridges Bay to Highland Creek) is comprised of coarse, clean material. Several stations show slight elevations in levels of total phosphorous which may be a reflection of the continuous influence of the Main STP discharges. Slight elevations in oil and grease at some stations and some arsenic at one station represent pockets of localized deposition in perhaps small depressions.

The station at the mounth of Highland Creek probably reflects the influence of the Highland Creek STP which until very recently discharged into the Creek near its mouth. Elevations in the level of oil and grease above this guideline were noted at this station.

# CHAPTER 6 - CONCLUSION

1. Considerable variation exists in sediment quality and type across the Toronto Waterfront. The two major factors influencing the sediment characteristics appear to be local discharges and hydrodynamic forces (waves and currents). Areas such as the Scarborough Bluffs - Eastern beaches sector of the waterfront which are exposed to waves and littoral currents, especially from the east, consist primarily of clean, coarse-grained material. Other areas such as lakefill embayments, Ashbridges Bay and Toronto Harbour are not under the influence of any significant water movement that would disperse fine material and contaminants. As a result, local discharges settle out in areas immediate to the various discharge points resulting in local areas of degraded bottom sediment.

2. The Don River, Humber River, Humber Sewage Treatment Plant and storm sewers are the most obvious sources having a profound influence on the quality of local sediments. The Eastern Headland appears to be a localized source of sediment and contaminants such as lead, oil and grease and PCB's.

3. The most degraded areas on the waterfront are the Inner Toronto Harbour and Humber Bay with localized pockets of less contaminated sediment throughout the waterfront. The pattern of contaminant distribution within Humber Bay raises the most serious concerns at this time. The build-up of contaminated sediments in the southeastern portion of the bay suggests that as the influence of waves and currents, and clean littoral sands from the east are further diminished as a result of the Eastern Headland, contamination from Humber Bay may spread eastward, across the south of Toronto Islands. The Toronto shelf may, however, influence this.

4. The influence of the Main Sewage Treatment Plant discharge and material lost during construction of the Eastern Headland on Humber Bay sediments is not known. The major force responsible for effecting changes in Humber Bay and south of Toronto Island appear to be waves from the southwest which may also be responsible for erosion along the south shore of the island. The buildup of eroded material at the southeastern tip of the island necessitated removal of about 31000$m^3$ of sand during 1983 (pers. comm. A. Khan, Public Works Canada).

5. Although mercury levels in sediments have declined significantly in many areas across the Province as a result of curtailment of use, removal of contaminated bottom sediments during navigational dredging and natural transport through scouring, levels above the MOE guidelines for open water disposal can still be found in the more contaminated areas of Toronto Waterfront. The levels likely reflect historic deposits rather than current inputs and point to the importance of adequate hydrodynamic forces in removing localized deposits after the sources have been controlled.

6. Any structural modification that changes wave and current patterns along the waterfront is likely to induce localized deposition of material. The location and design of structures, such as lakefills, should be carried out so as to minimize the creation of embayments that could trap contaminated material. New discharges to the waterfront should be located so as to maximize dispersion of the discharges.

7. The impacts of contaminants in sediments on water quality and the ecosystem along the waterfront is under study through MOE's "Inplace Pollutants Program". During recent years, the Ministry monitored water quality at both the R.C. Harris and Island filtration plants to determine the impacts of sediments from dredging and lakefilling on drinking water quality. The result of these studies show no discernible effects that could be attributed to sediment since the water supply to both these plants remain of excellent quality.

8. The movement of contaminants and sediments along the waterfront is poorly understood and warrants further investigation which should provide an understanding of material transport especially in and out of Humber Bay.

## REFERENCES


Central Waterfront Planning Committee. 1976. The Central Waterfront Information Base Study-Environment. City of Toronto Planning Board.

Dougenik, J.A. and D.E. Sheehan. 1976. SYMAP User's Manual. Laboratory for Computer Graphics and Spatial Analyses, Harvard University, U.S.A.

Forstner, U. and G.T.W. Wittmann. 1981. Metal Pollution in the Aquatic Environment. Springer-Verlag, New York, U.S.A.

Fricbergs, K.S. 1970. Erosion Control in the Toronto Area. Proc. 13th Conf. Great Lakes Res., 751-755.

Greenwood, B. and M. McGillvray. 1978. Theoretical Model of the Littoral Drift System in the Toronto Waterfront Area, Lake Ontario. J. Great Lakes Res., 4(1), 84-102.

Hare, F.K. and M.K. Thomas. 1974. Climate Canada. John Wiley & Sons, Toronto.

International Joint Commission. 1983. Report on Great Lakes Water Quality. Windsor, Ont.

Kindle, E.M. 1925. The Bottom Deposits of Lake Ontario. Trans-Royal Soc. Canada.

Lewis, C.F.M. and P.G. Sly. 1971. Seismic Profiling and Geology of the Toronto Waterfront Area of Lake Ontario. Proc. 14th. Conf. Great Lakes Res., 303-354.

Metropolitan Toronto and Region Conservation Authority. 1981. Waterfront Environmental Monitoring Program, 1981. Metropolitan Toronto and Region Conservation Authority, Toronto.

Metropolitan Toronto and Region Conservation Authority. 1978. Waterfront Environmental Monitoring Program, 1977. Metropolitan Toronto And Region Conservation Authority, Toronto.

Ontario Ministry of the Environment. 1983. Handbook of analytical Methods for Environmental samples. Laboratory Services and Applied Research.

Ontario Ministry of the Environment. 1983 (unpublished). Sediment Survey behind the Humber Bay Breakwall. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1982 (unpublished). Sediment Survey along the Toronto Waterfront. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1981. Outlines of Analytical Methods. Ontario Ministry of the Environment, Laboratory Services Branch, Toronto.

Ontario Ministry of the Environment. 1981. A Summary Report on the Effects of Dredging, Dredged Spoils Disposal and Lakefilling Activities on Water Quality in the Toronto Waterfront August 15 - November 29, 1980. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1980 (unpublished). Sediment Survey of Toronto Inner Harbour. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1979 (unpublished). Humber Bay Sediment Survey. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1978 (unpublished). Survey of Toronto Inner Harbour. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1977 (unpublished). Sediment Survey of Toronto Inner and Outer Harbour. Ontario Ministry of the Environment, Toronto.

Ontario Ministry of the Environment. 1976 (unpublished). Entensive Sediment Survey of the Toronto Inner and Outer Harbour. Ontario Ministry of the Environment.

Persaud, D. and W.D. Wilkins. 1976. Evaluating Construction activities Impacting on water resources. Ministry of the Environment. Toronto, Ontario.

Rubinstein, N.I., C.N. D'Asaro, C. Sommers and F.G. Wilkins. 1980. "The Effects of Contaminated Sediments on Representative Estuarine Species and Developing Benthic Communities". Contaminants and Sediments, Vol.1, R.A. Baker, ed. Ann Arbor Science Publishers, Inc. Michigan, United States.

Rukavina, N.A. 1976. Nearshore Sediments of Lake Ontario and Lake Erie. Geoscience Canada. 3(3)., 185-190.

Rukavina, N.A. 1969. Nearshore Sediment Survey of Western Lake Ontario, Methods and Preliminary Results. Proc. 12th. Conf. Great Lakes Res., 317-324. International Assoc. Great Lakes Res.

Simpson, W.G. and G.K. Rodgers. 1970. Currents in Lake Ontario Near Toronto. Proc. 13th. Conf. Great Lakes Res., 528-539.

Thomas, R.L., A.L.W. Kemp and C.F.M. Lewis. 1972. Distribution, Composition and Characteristics of the Surficial Sediments of Lake Ontario. J. Sed. Pet., 42(1)., 66-84.

Toronto Harbour Commissioners. 1983. Outer Harbour East Headland Progress Report, Engineering Dept., Unpublished.

Toronto Harbour Commissioners. 1980. Port and Harbour of Toronto. THC Drawing No. 16820.

Toronto Harbour Commissioners. 1975. Dredged Material Disposal Study Phase II, Technical Data, Unpublished.

Wilkins, W.D. 1974. Sediment Quality on the Toronto Waterfront. Water Resources Branch, Ontario Ministry of the Environment, Toronto.

# HISTORICAL DEVELOPMENT AND QUALITY OF THE TORONTO WATERFRONT SEDIMENTS- PART I

## APPENDIX

Ministry of the Environment

FIGURES (A.1-1) - (A.1-15)

PLEASE REFER TO SECTION 3 OF THE MAIN REPORT
FOR THE STATION LOCATIONS

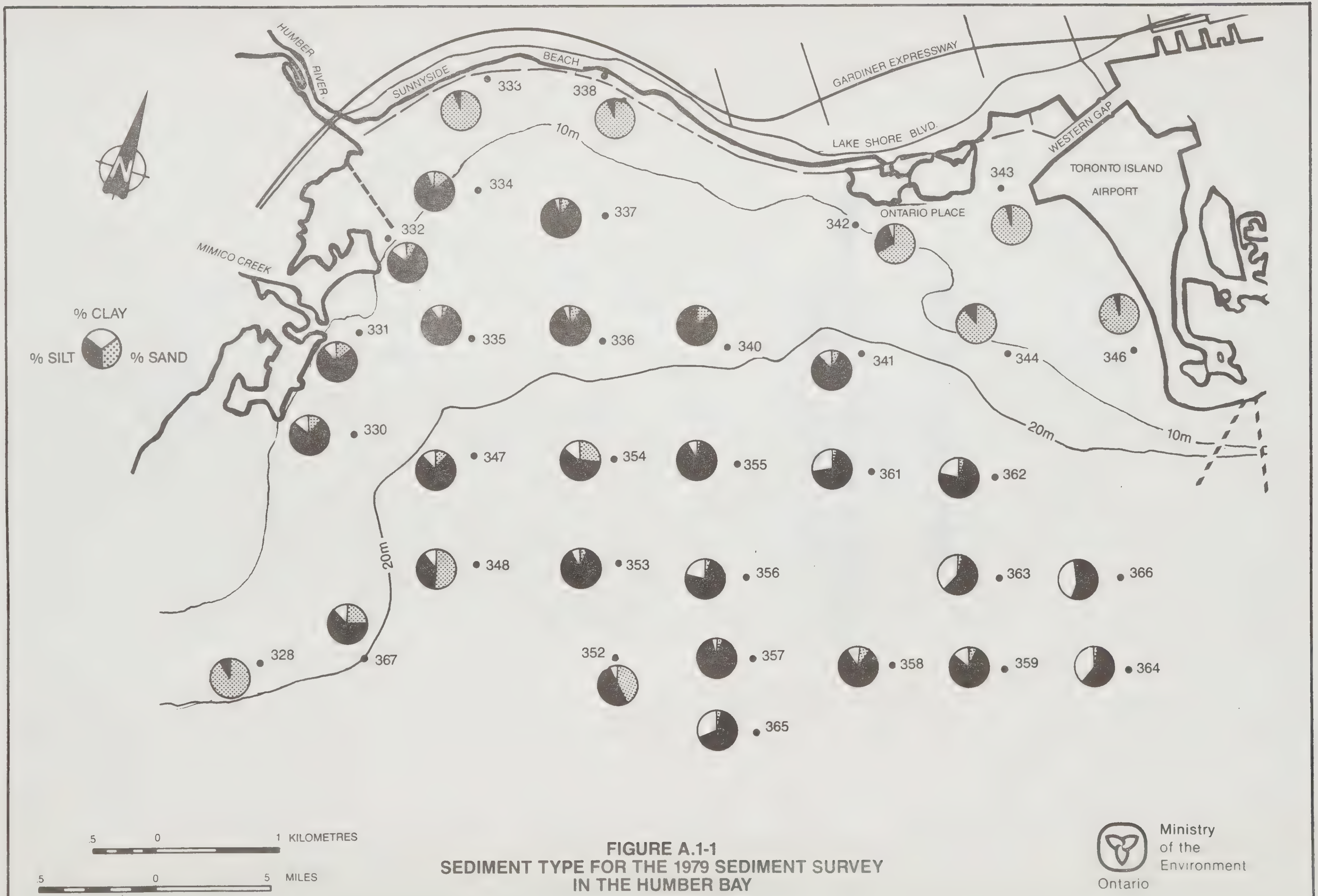



**FIGURE A.1-1**
**SEDIMENT TYPE FOR THE 1979 SEDIMENT SURVEY IN THE HUMBER BAY**

Ministry of the Environment
Ontario

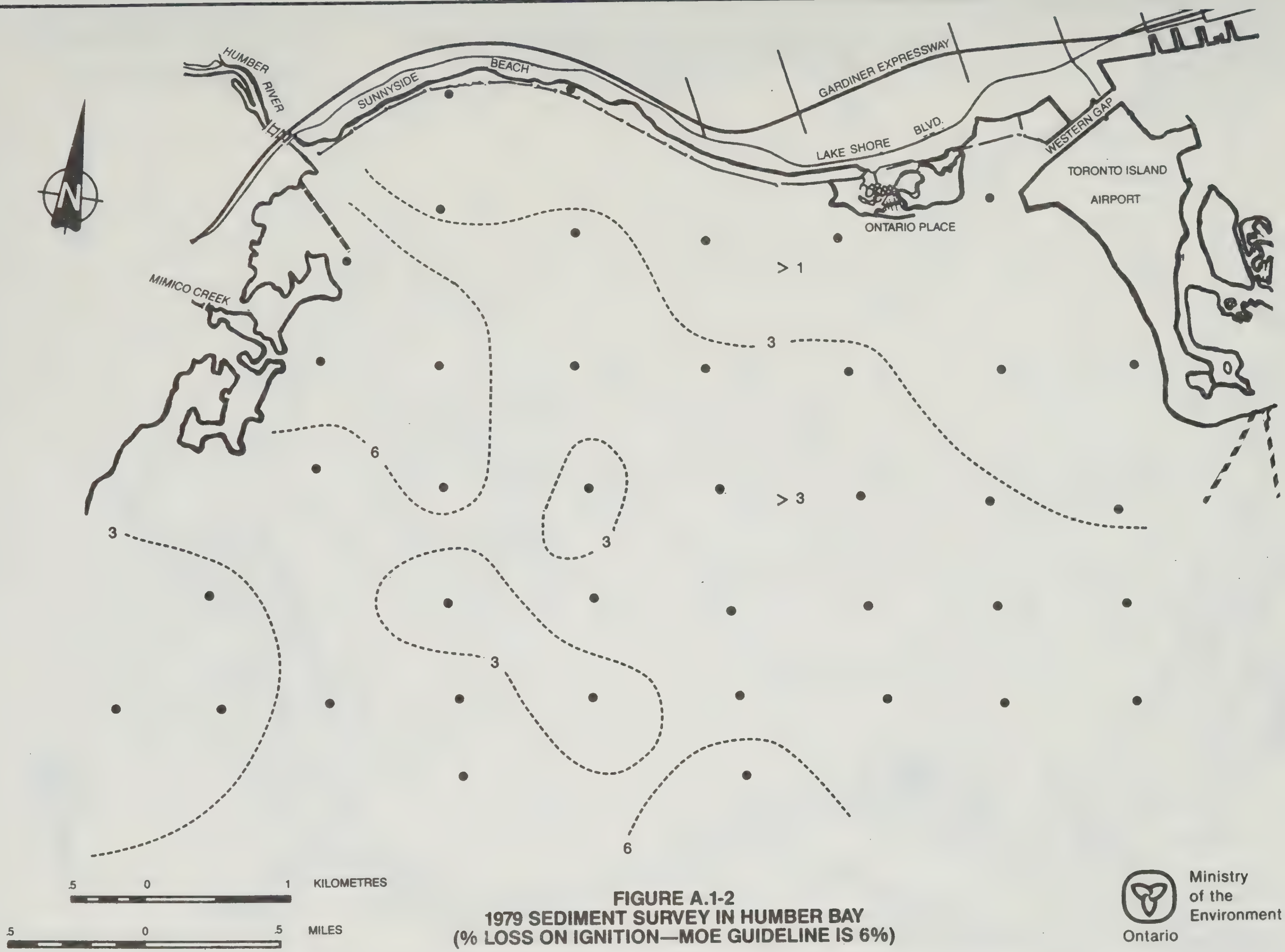



**FIGURE A.1-2**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(% LOSS ON IGNITION—MOE GUIDELINE IS 6%)**

Ministry
of the
Environment
Ontario

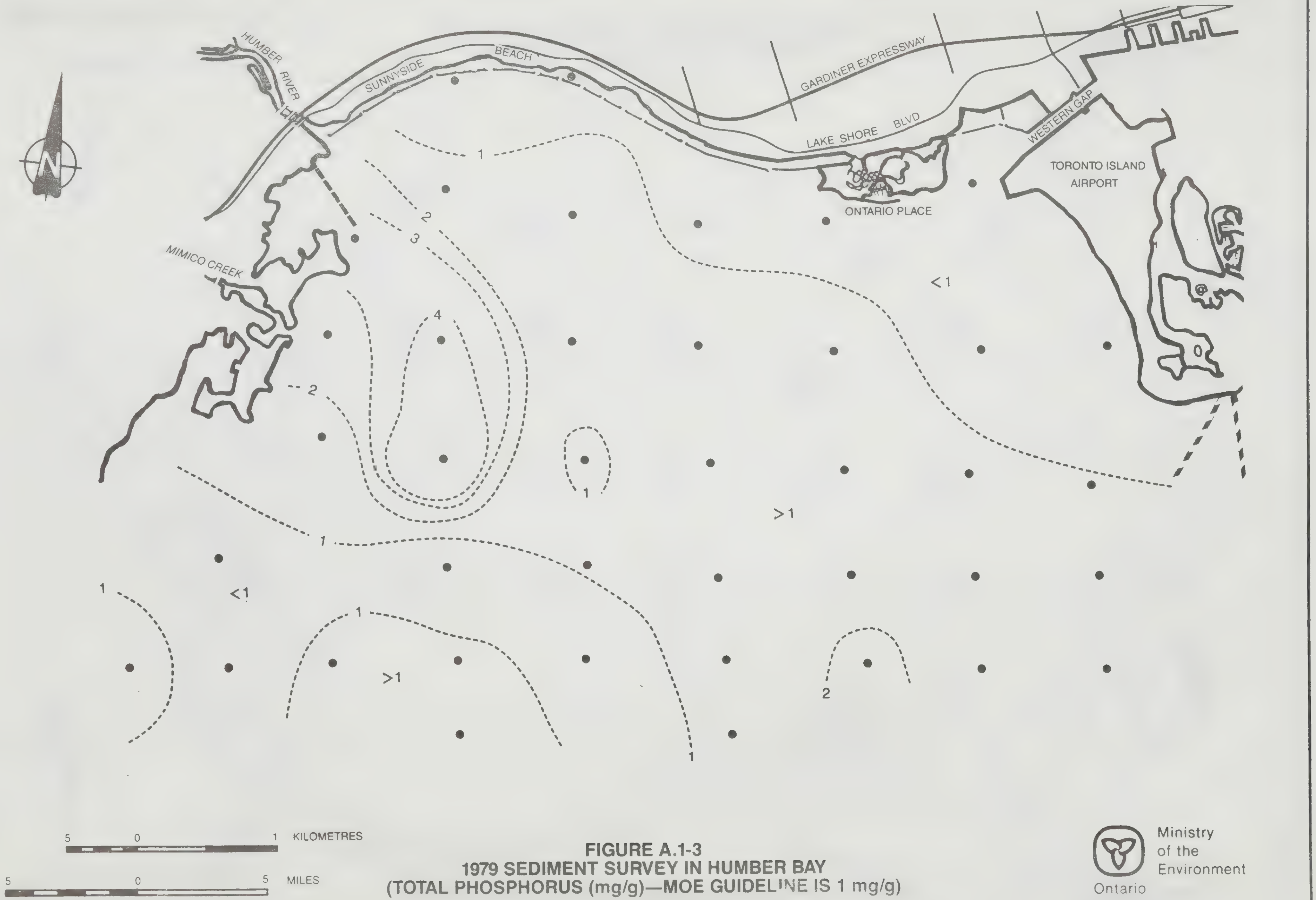



FIGURE A.1-3
1979 SEDIMENT SURVEY IN HUMBER BAY
(TOTAL PHOSPHORUS (mg/g)—MOE GUIDELINE IS 1 mg/g)

Ministry of the Environment
Ontario

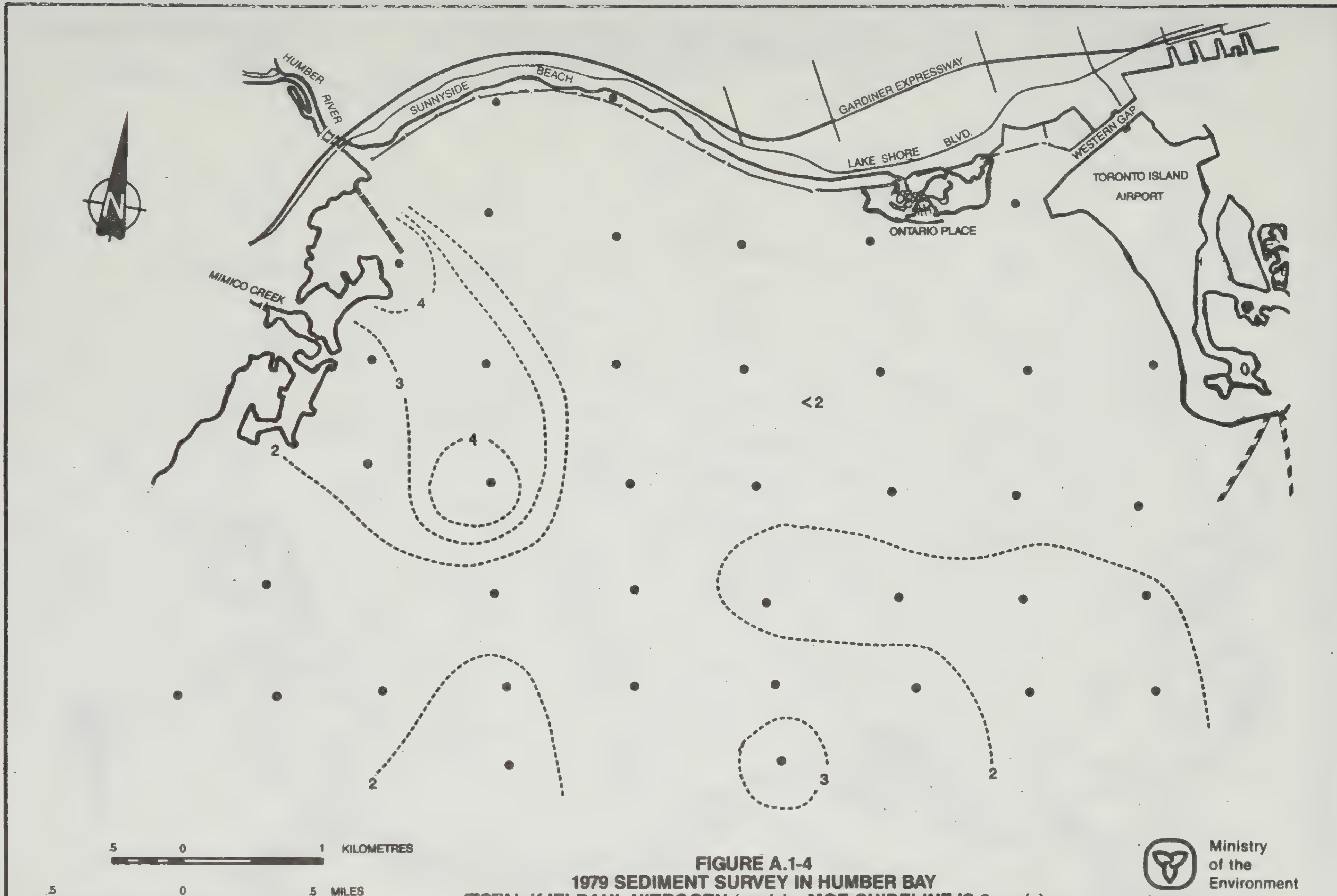



**FIGURE A.1-4**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(TOTAL KJELDAHL NITROGEN (mg/g)—MOE GUIDELINE IS 2 mg/g)**

Ministry of the Environment
Ontario

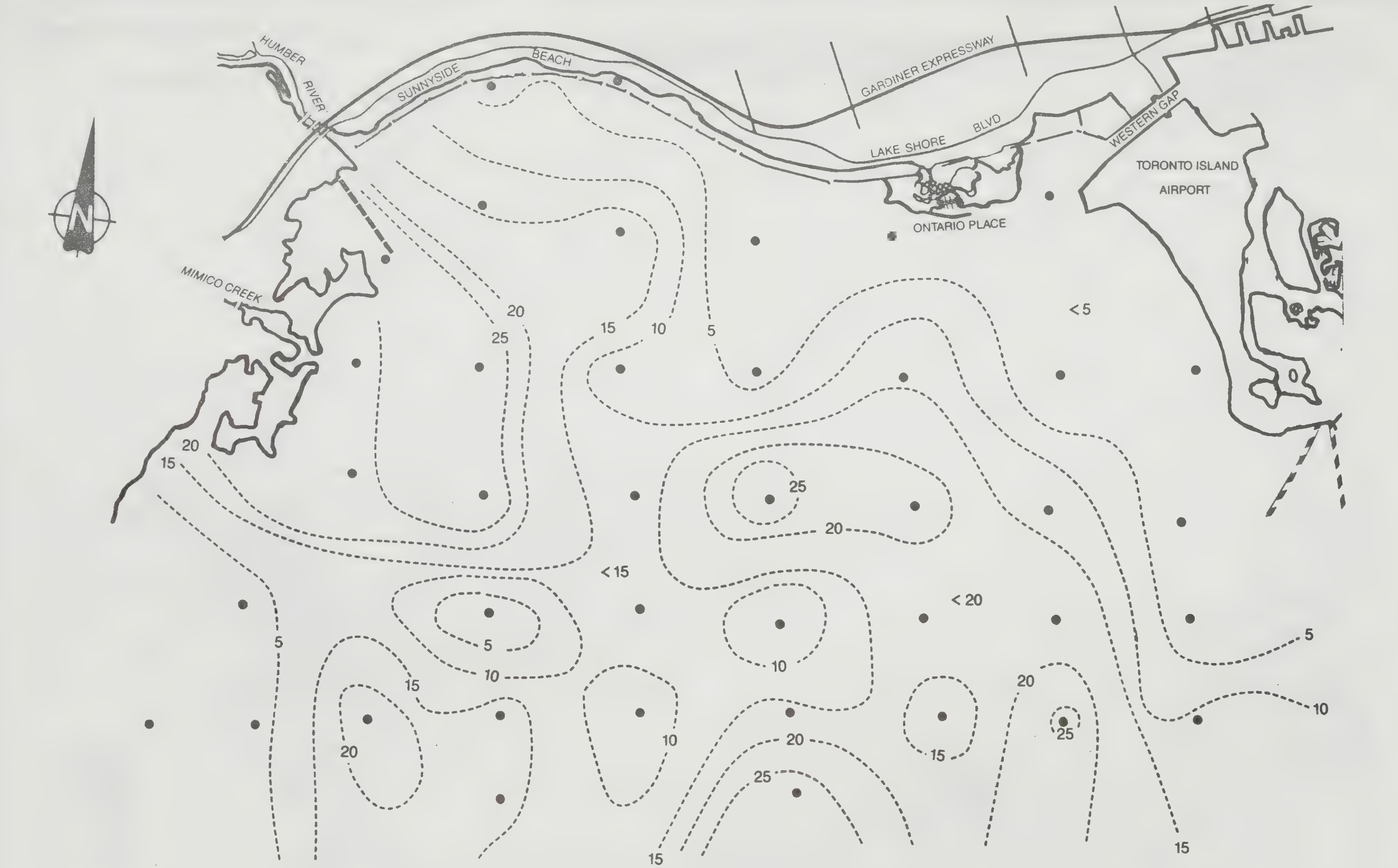



FIGURE A.1-5
1979 SEDIMENT SURVEY IN HUMBER BAY
(TOTAL ORGANIC CARBON (mg/g)—MOE GUIDELINE IS 10 mg/g)

Ministry
of the
Environment
Ontario

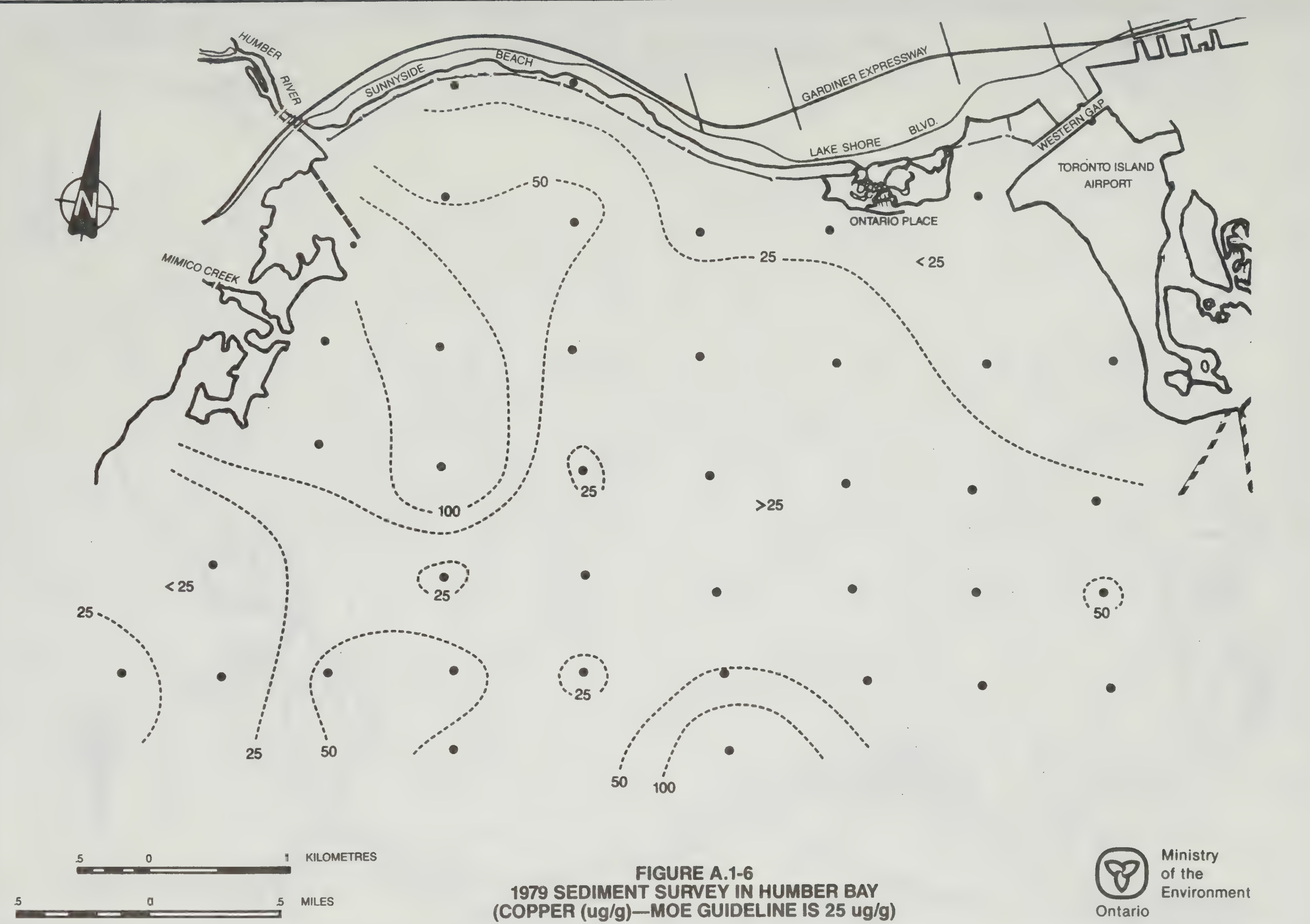



FIGURE A.1-6
1979 SEDIMENT SURVEY IN HUMBER BAY
(COPPER (ug/g)—MOE GUIDELINE IS 25 ug/g)

Ministry of the Environment
Ontario

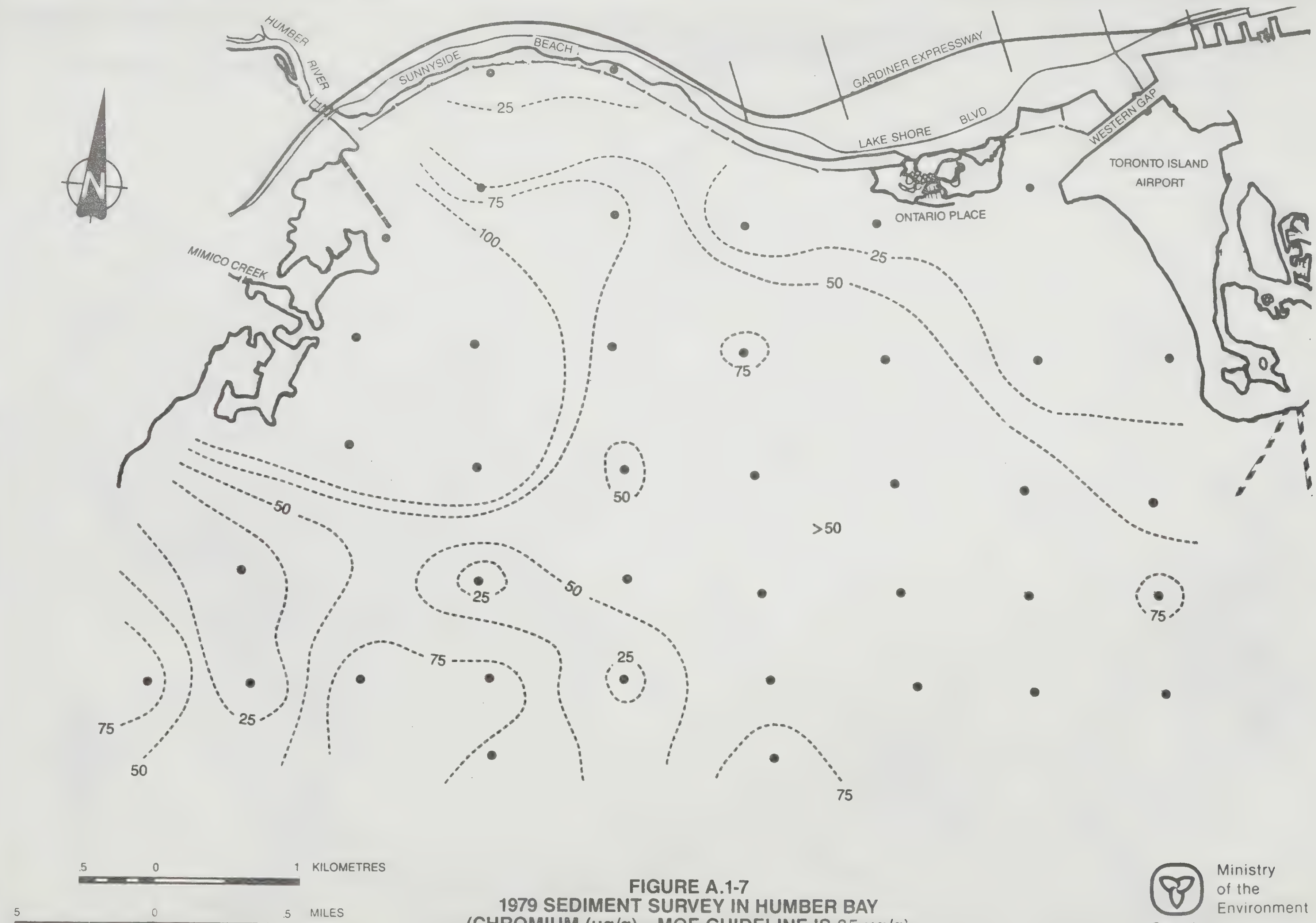



**FIGURE A.1-7**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(CHROMIUM (ug/g)—MOE GUIDELINE IS 25 ug/g)**

Ministry of the Environment
Ontario


**FIGURE A.1-8**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(MERCURY (ug/g)—MOE GUIDELINE IS 0.3 ug/g)**

Ministry of the Environment
Ontario

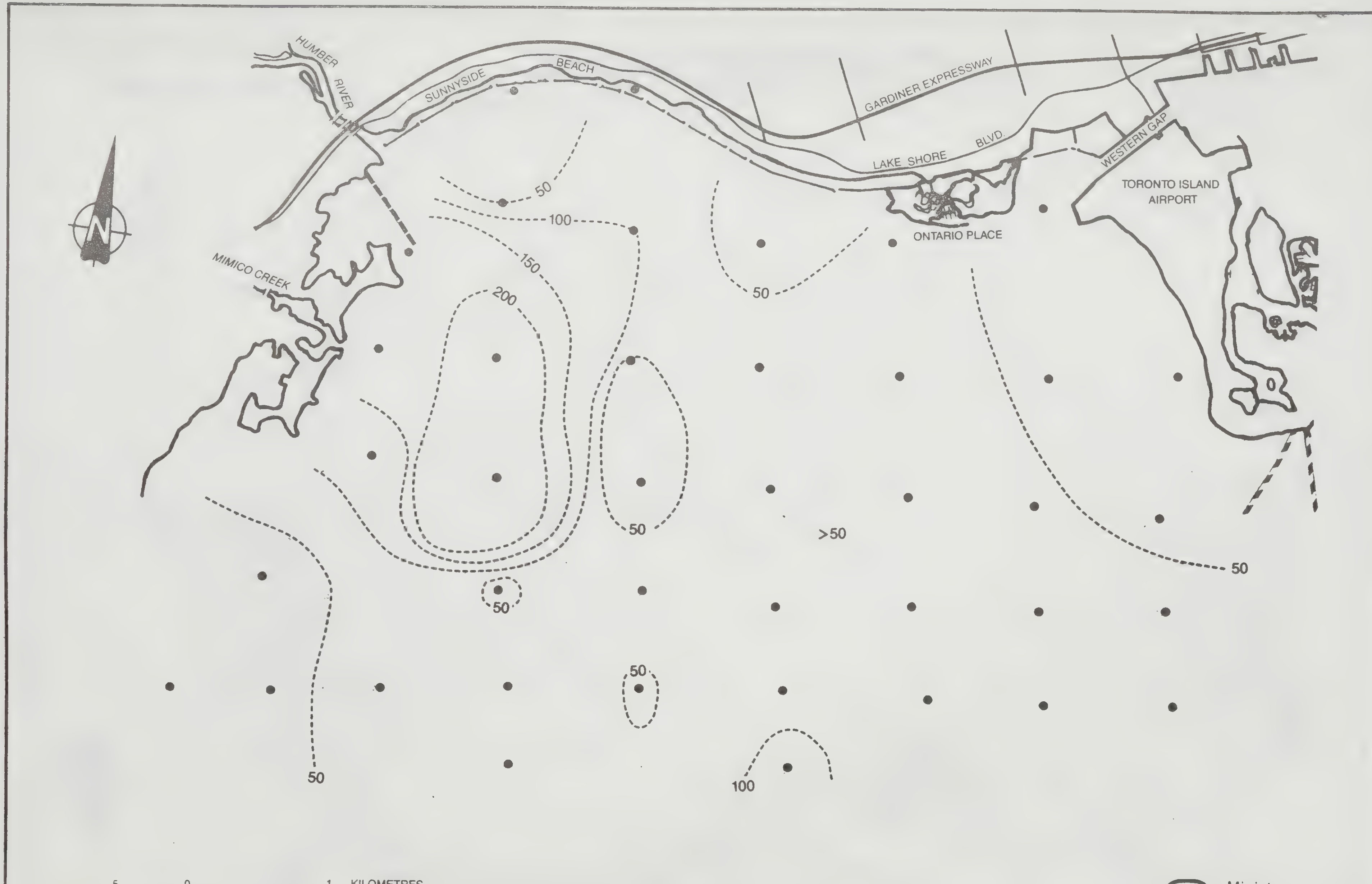



**FIGURE A.1-9**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(LEAD (ug/g)—MOE GUIDELINE IS 50 ug/g)**

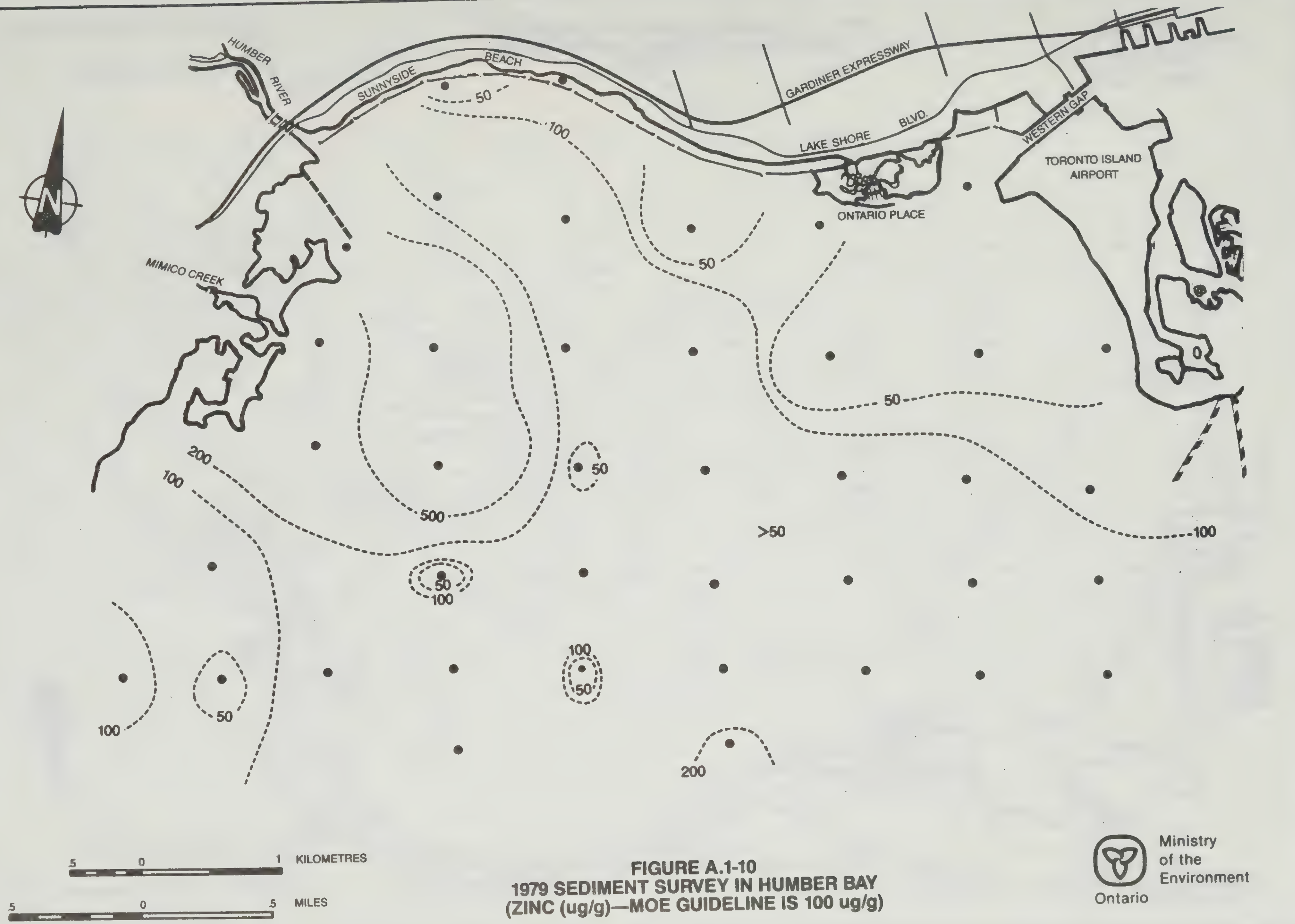



FIGURE A.1-10
1979 SEDIMENT SURVEY IN HUMBER BAY
(ZINC (ug/g)—MOE GUIDELINE IS 100 ug/g)

Ministry of the Environment
Ontario

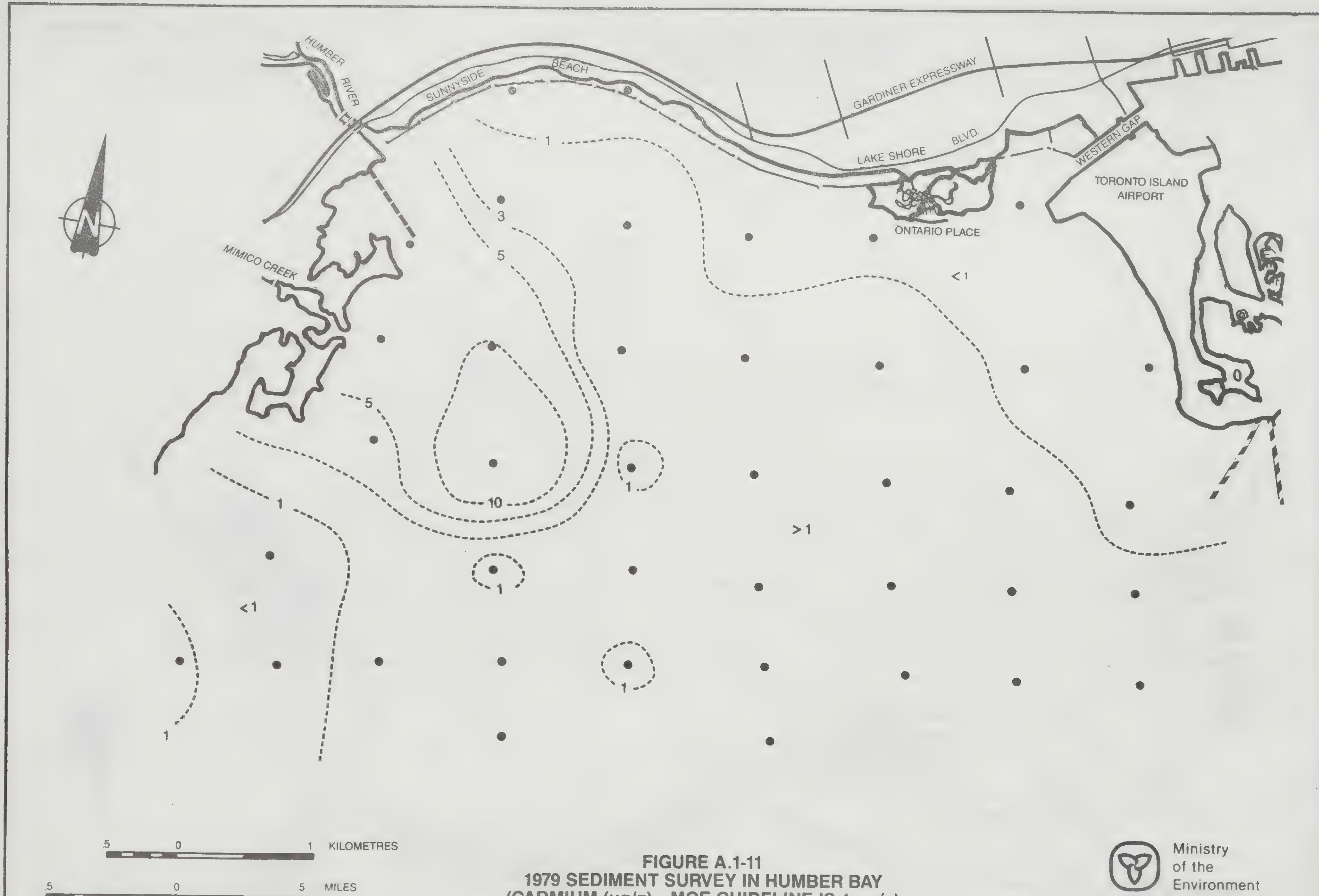



**FIGURE A.1-11**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(CADMIUM (ug/g)—MOE GUIDELINE IS 1 ug/g)**

Ministry of the Environment
Ontario


FIGURE A.1-12
1979 SEDIMENT SURVEY IN HUMBER BAY
(SOLVENT EXTRACTABLES (ug/g)—MOE GUIDELINE IS 1500 ug/g)

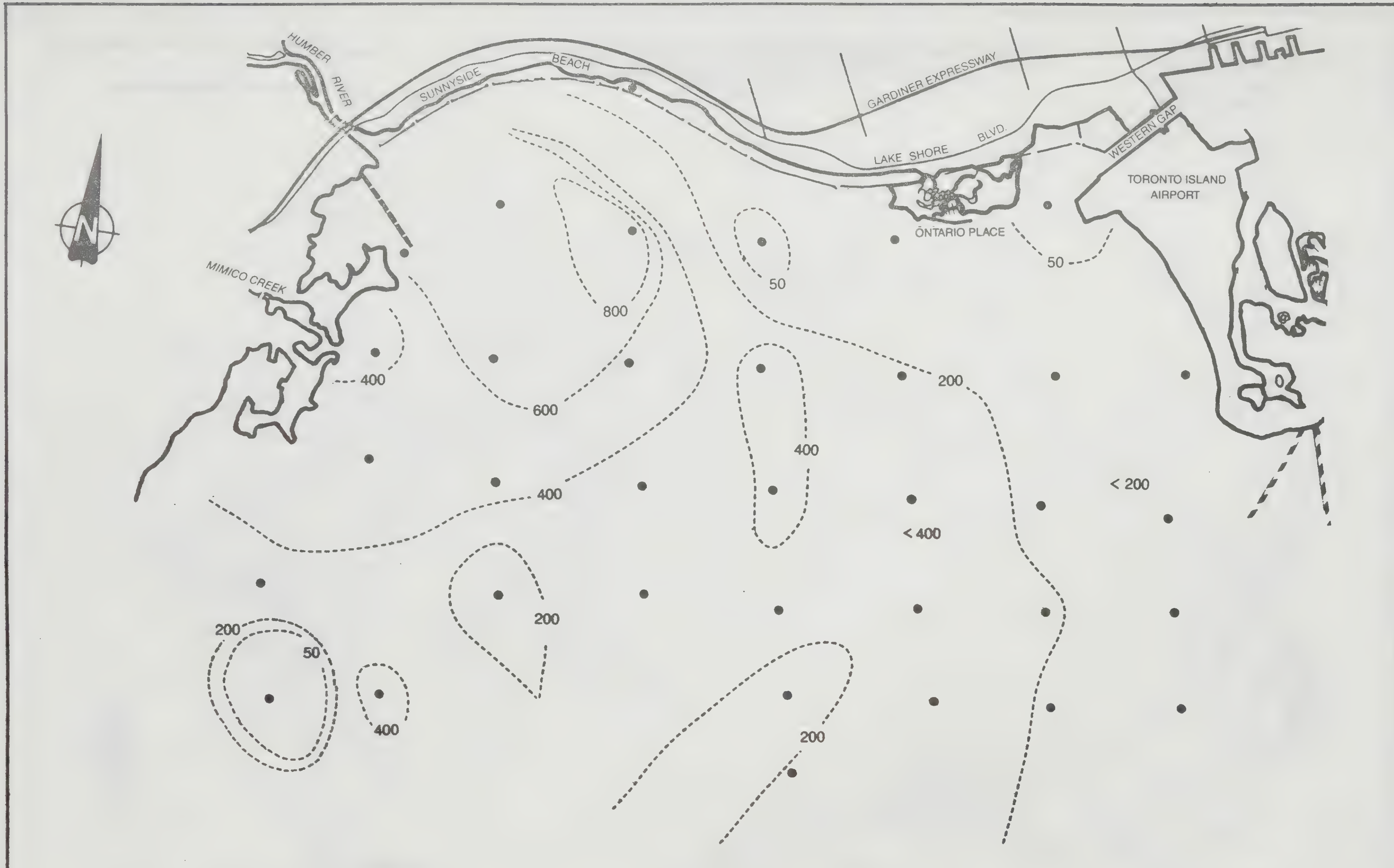



**FIGURE A.1-13**
**1979 SEDIMENT SURVEY IN HUMBER BAY**
**(PCB'S (ng/g)—MOE GUIDELINE IS 50 ng/g)**

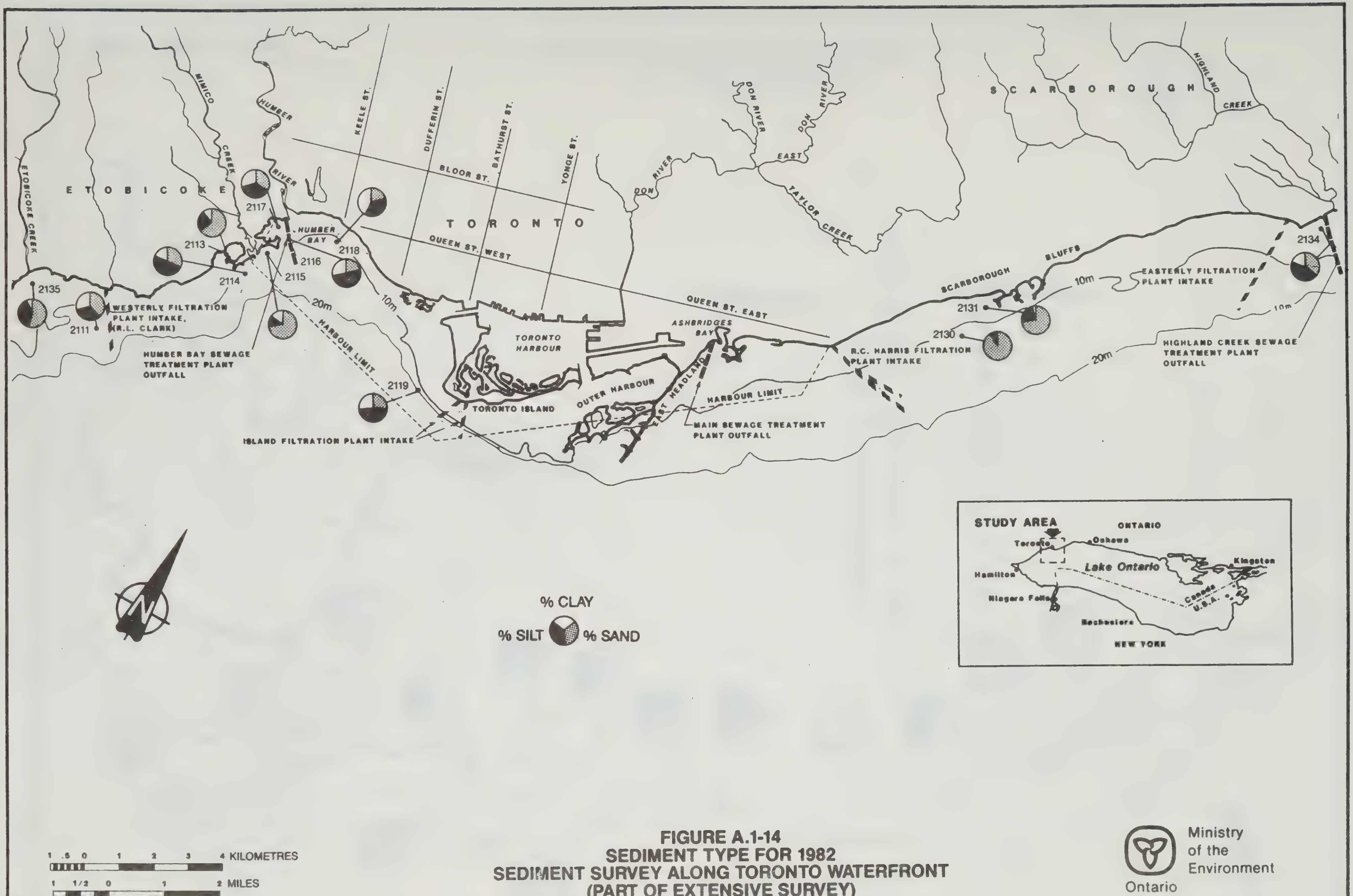



**FIGURE A.1-14**
**SEDIMENT TYPE FOR 1982**
**SEDIMENT SURVEY ALONG TORONTO WATERFRONT**
**(PART OF EXTENSIVE SURVEY)**

Ministry of the Environment
Ontario

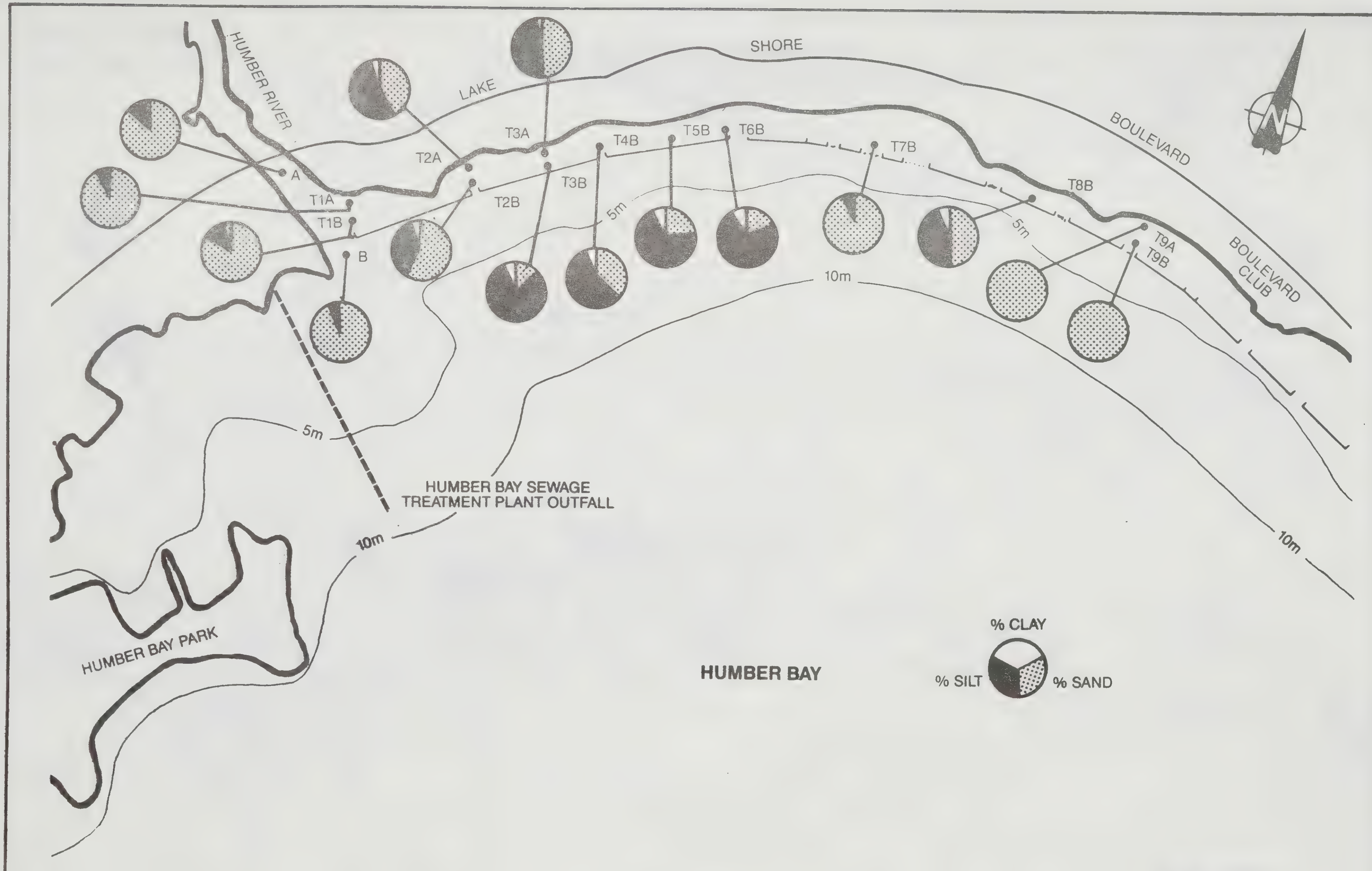



**FIGURE A.1-15**
**SEDIMENT TYPE FOR 1983**
**SEDIMENT SURVEY IN HUMBER BAY BEACHES AREA**

FIGURES (A.2-1) - (A.2-12)

PLEASE REFER TO SECTION 3 OF THE MAIN REPORT
FOR THE STATION LOCATIONS


**FIGURE A.2-1**
**SEDIMENT TYPE FOR THE 1982 SEDIMENT SURVEY IN THE OUTER HARBOUR AND EAST HEADLAND AREA**

Ontario
Ministry of the Environment


.5 0 1 KILOMETRES

.5 0 .5 MILES

FIGURE A.2-2
1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA
(% LOSS ON IGNITION—MOE GUIDELINE IS 6%)

Ministry of the Environment
Ontario

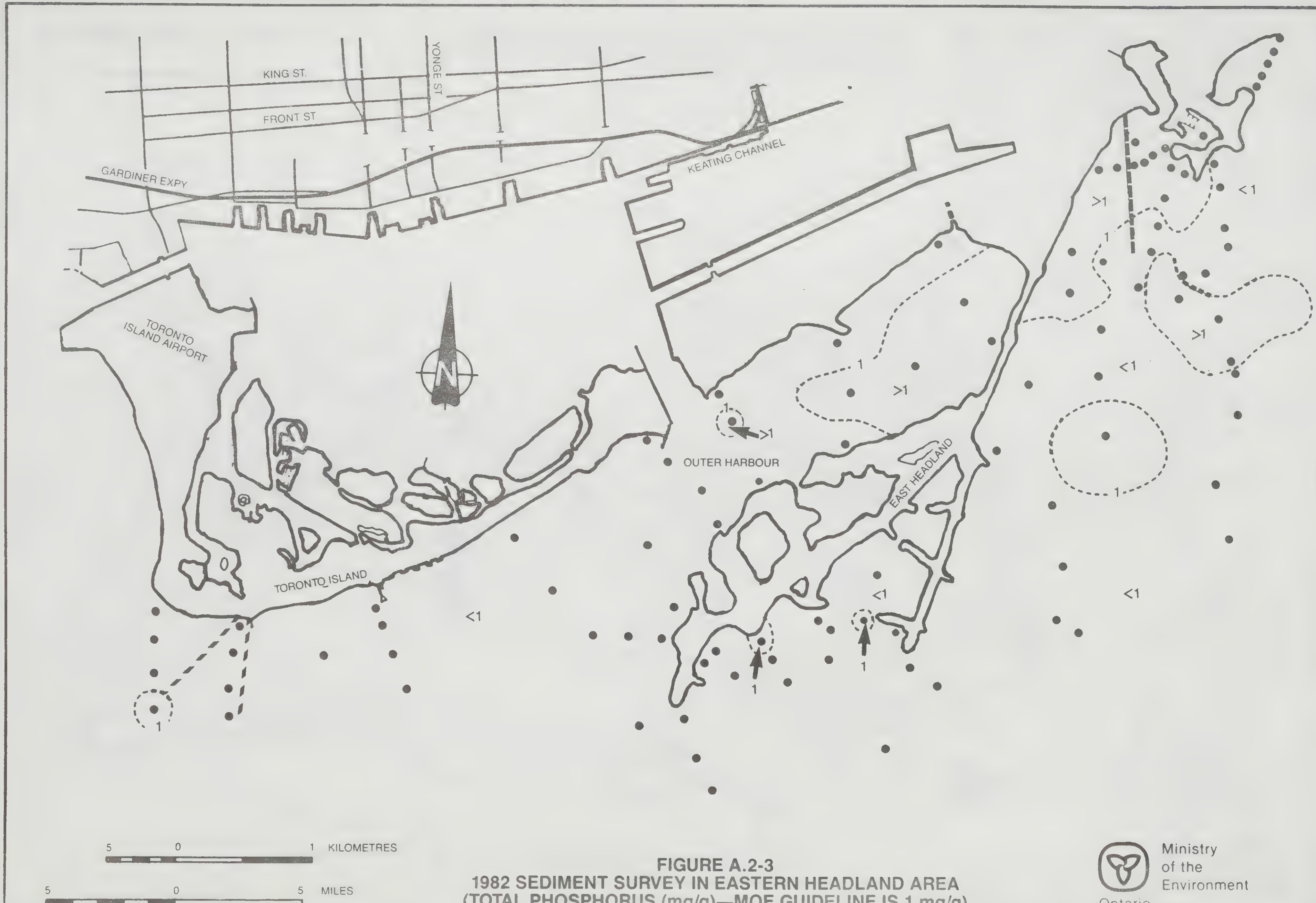
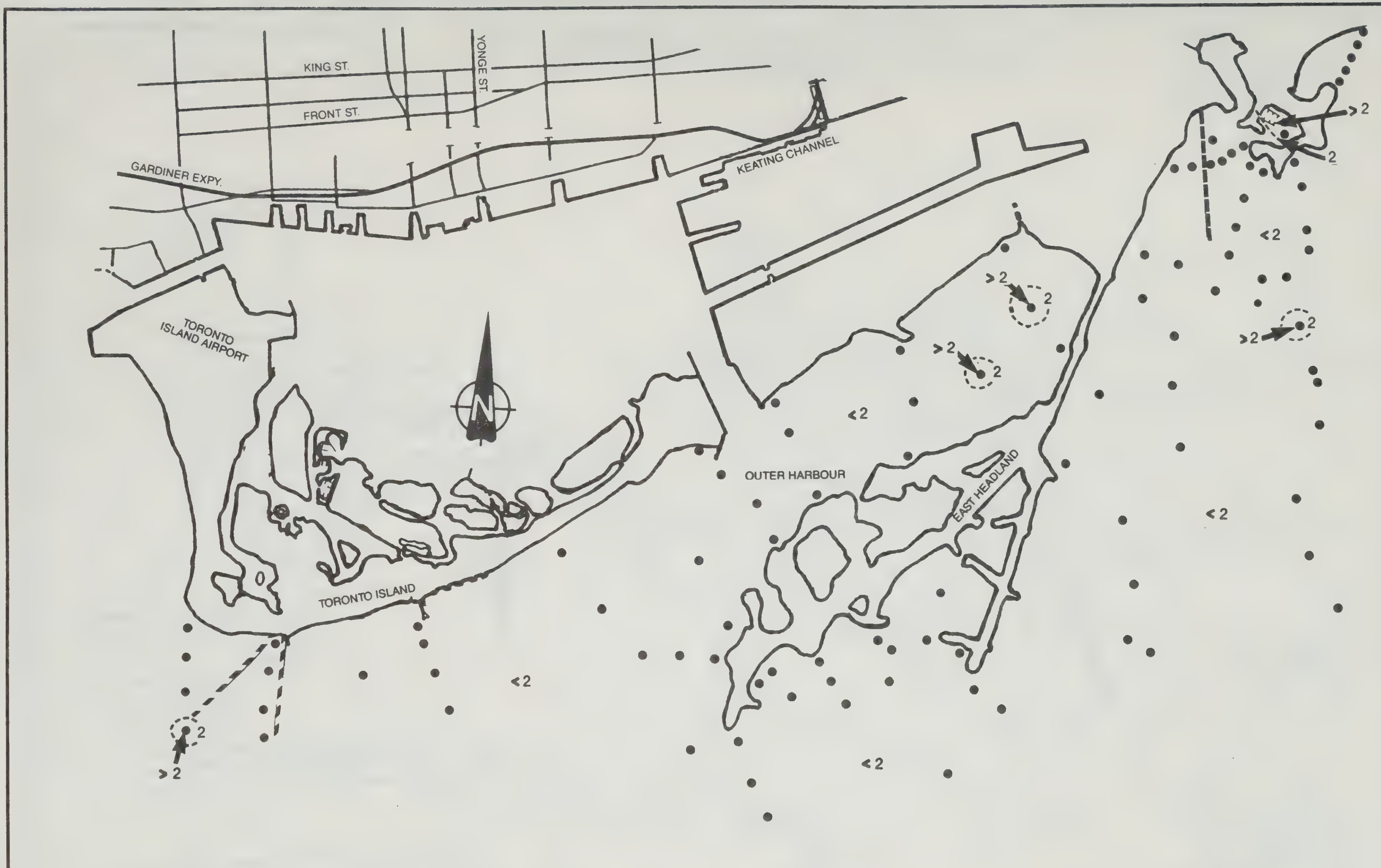



**FIGURE A.2-3**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(TOTAL PHOSPHORUS (mg/g)—MOE GUIDELINE IS 1 mg/g)**

Ministry of the Environment
Ontario




.5 0 1 KILOMETRES
.5 0 .5 MILES

**FIGURE A.2-4**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(TOTAL KJELDAHL NITROGEN (mg/g)—MOE GUIDELINE IS 2 mg/g)**

Ministry of the Environment
Ontario

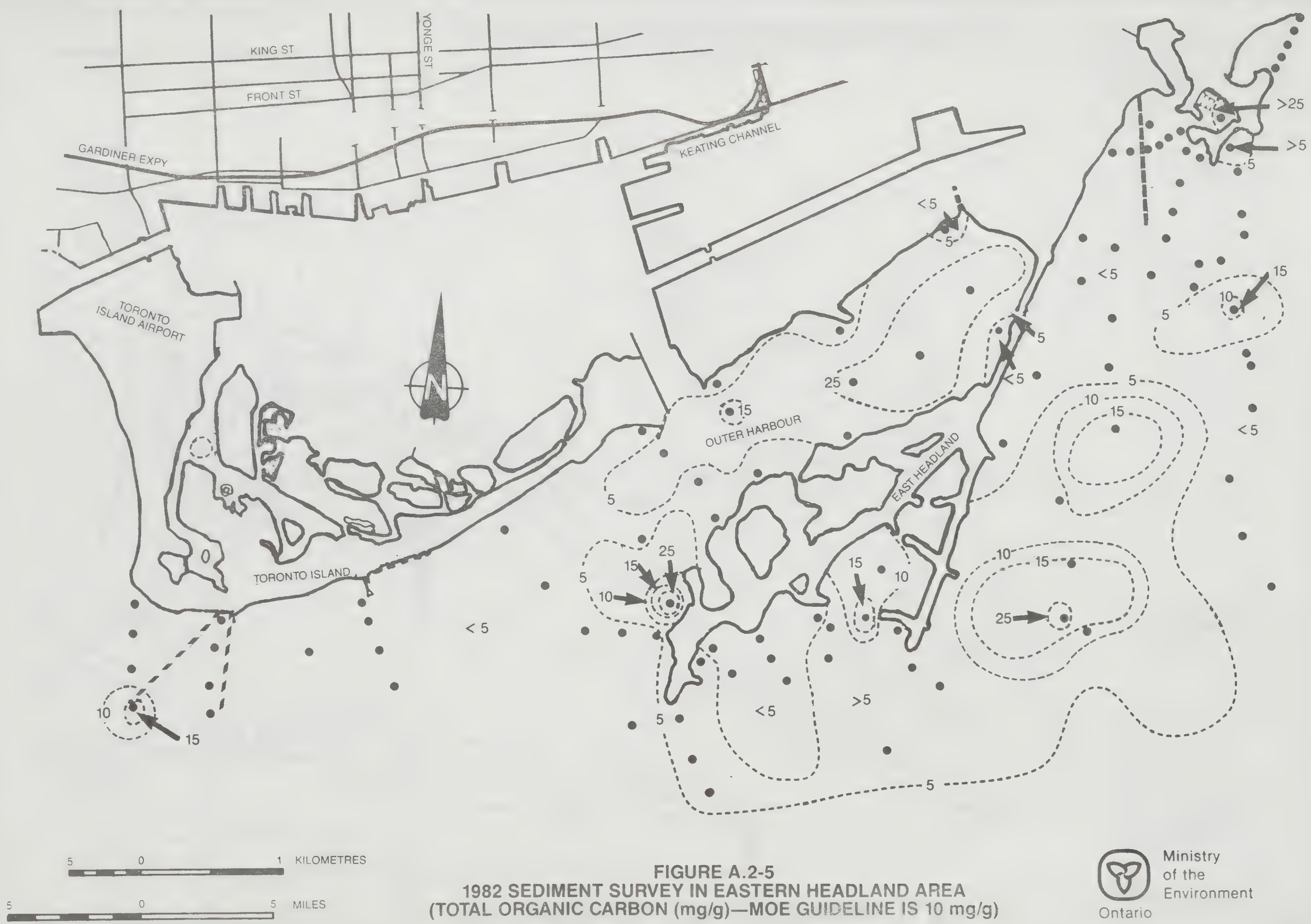



**FIGURE A.2-5**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(TOTAL ORGANIC CARBON (mg/g)—MOE GUIDELINE IS 10 mg/g)**

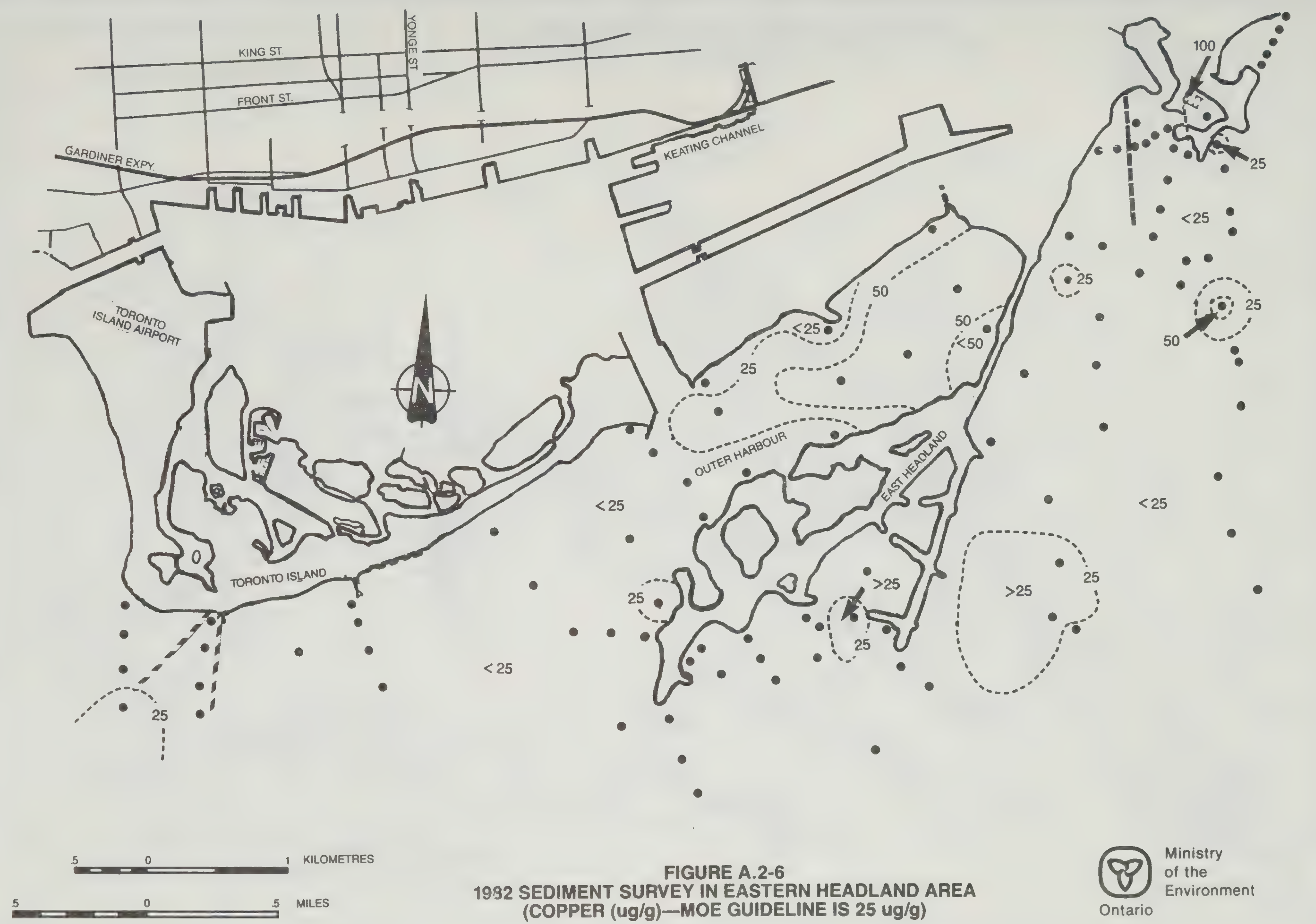



**FIGURE A.2-6**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(COPPER (ug/g)—MOE GUIDELINE IS 25 ug/g)**

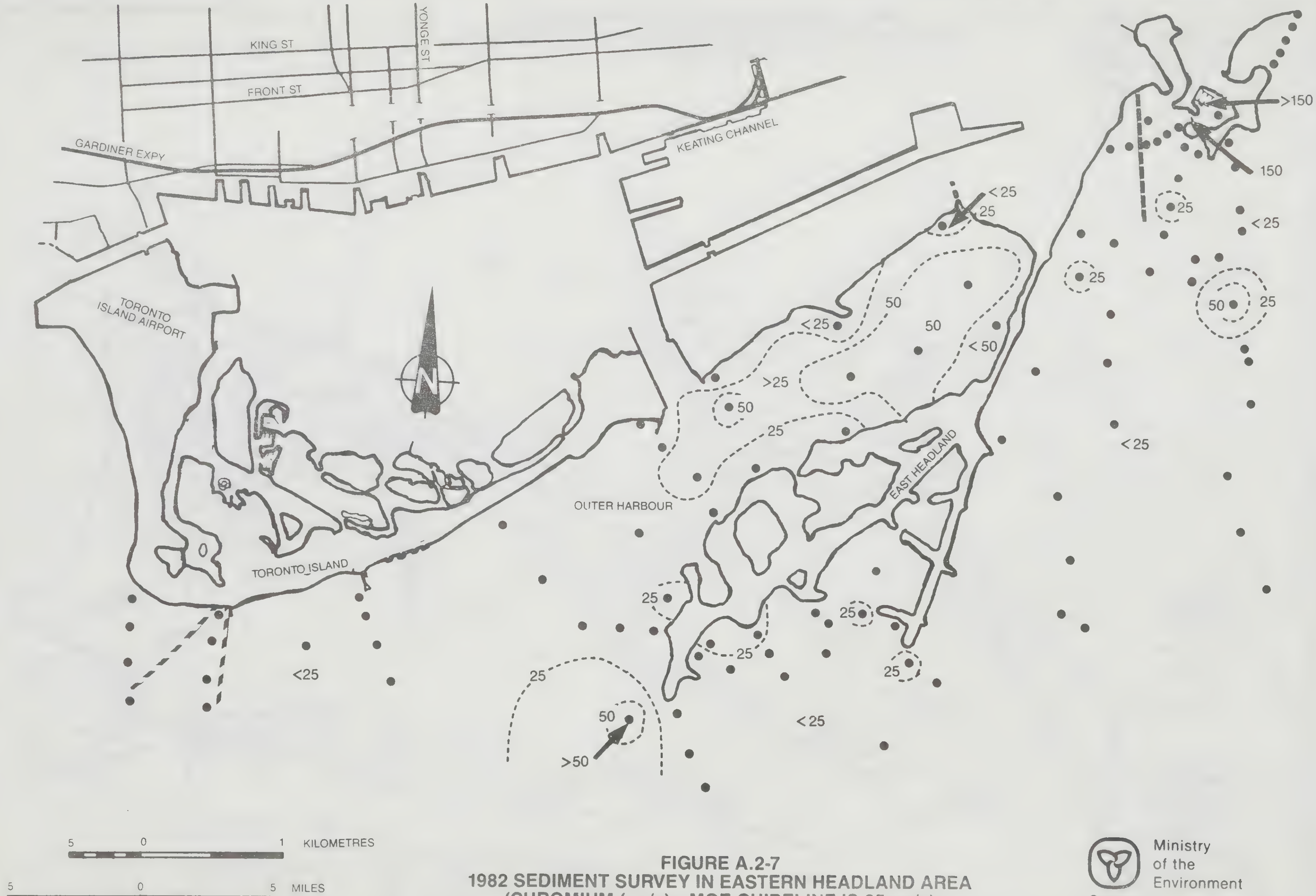



**FIGURE A.2-7**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(CHROMIUM (ug/g)—MOE GUIDELINE IS 25 ug/g)**

Ministry of the Environment
Ontario


.5 0 1 KILOMETRES

.5 0 .5 MILES

**FIGURE A.2-8**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(MERCURY (ug/g)—MOE GUIDELINE IS 0.3 ug/g)**

Ministry
of the
Environment
Ontario

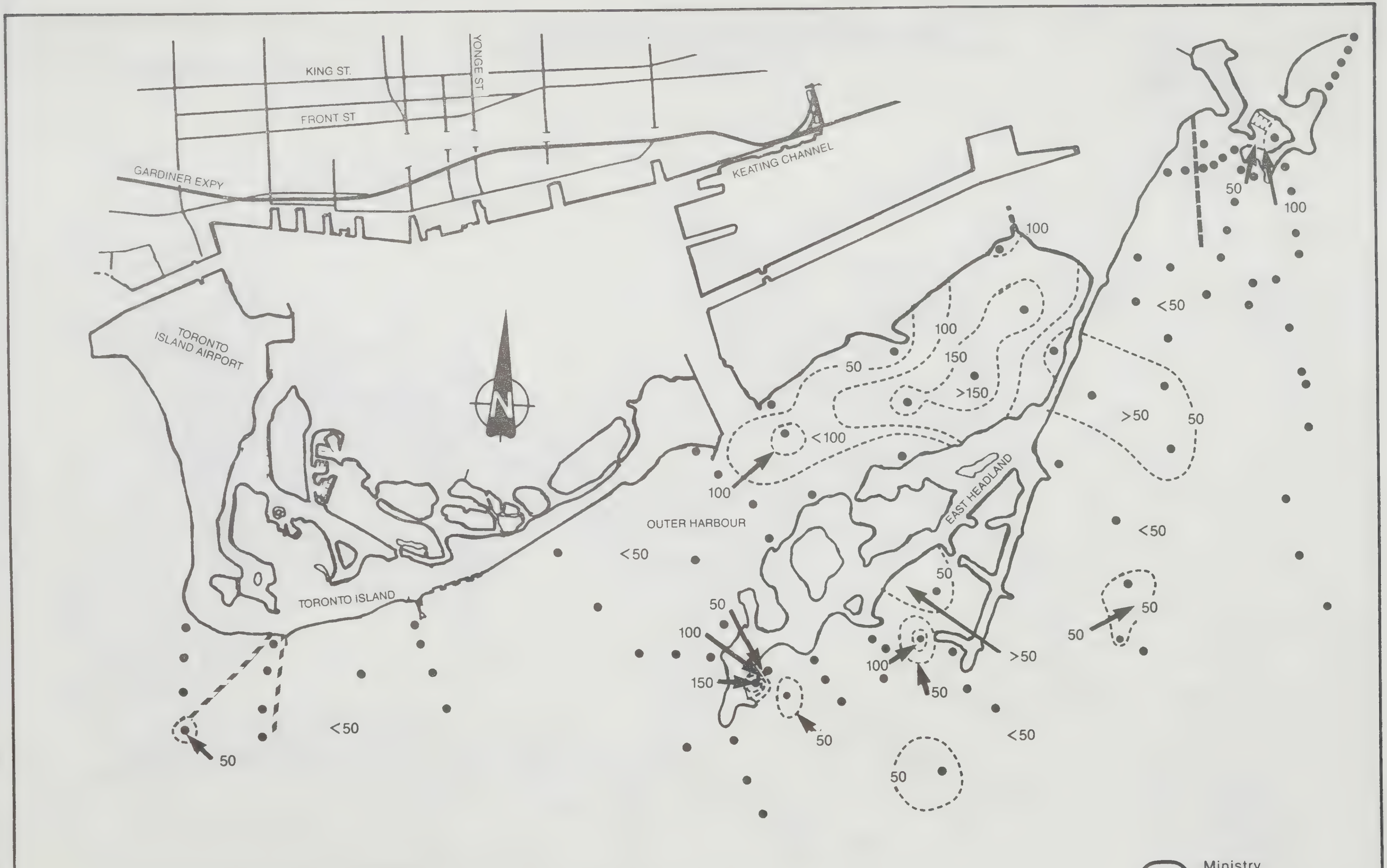



**FIGURE A.2-9**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(LEAD (ug/g)—MOE GUIDELINE IS 50 ug/g)**

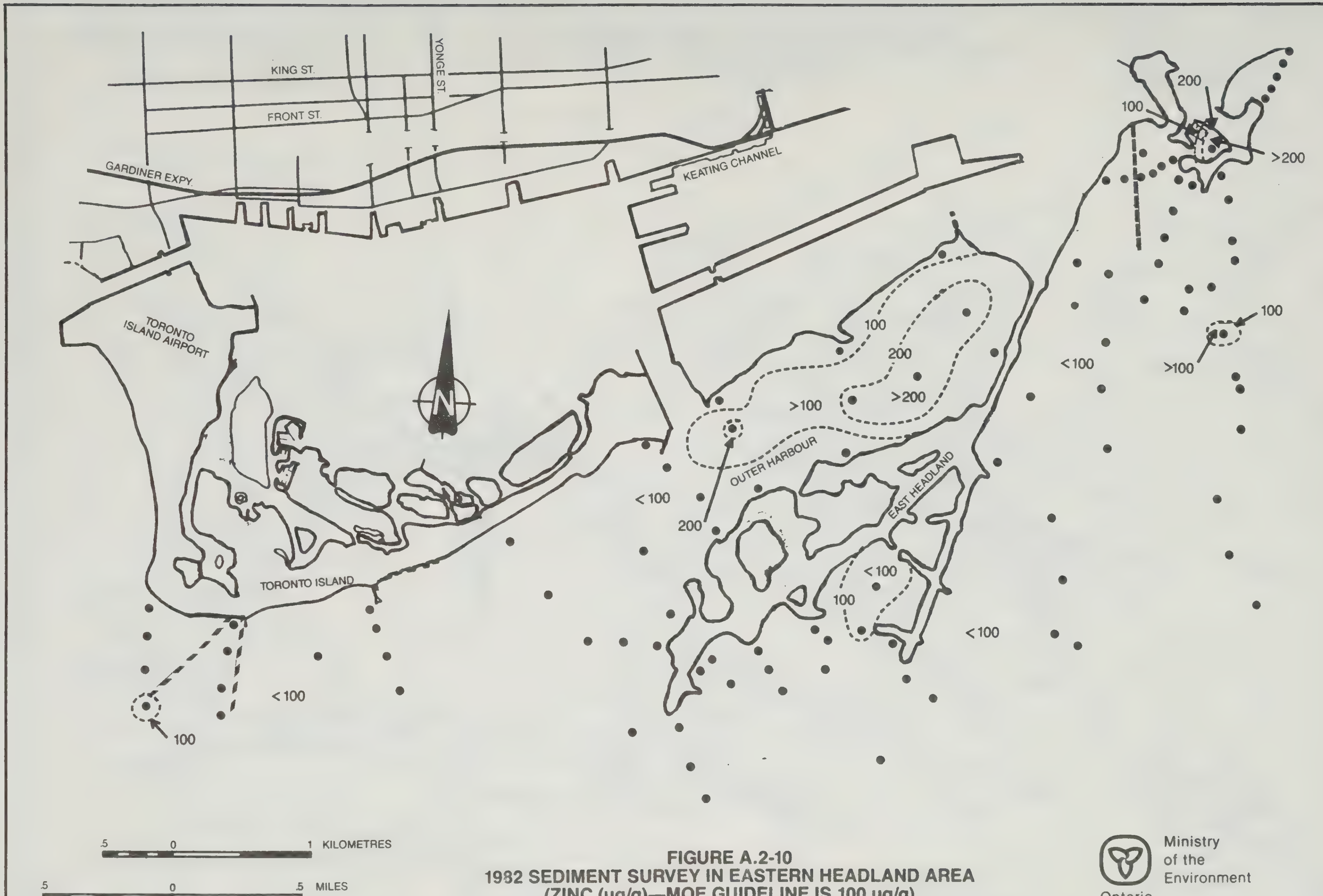
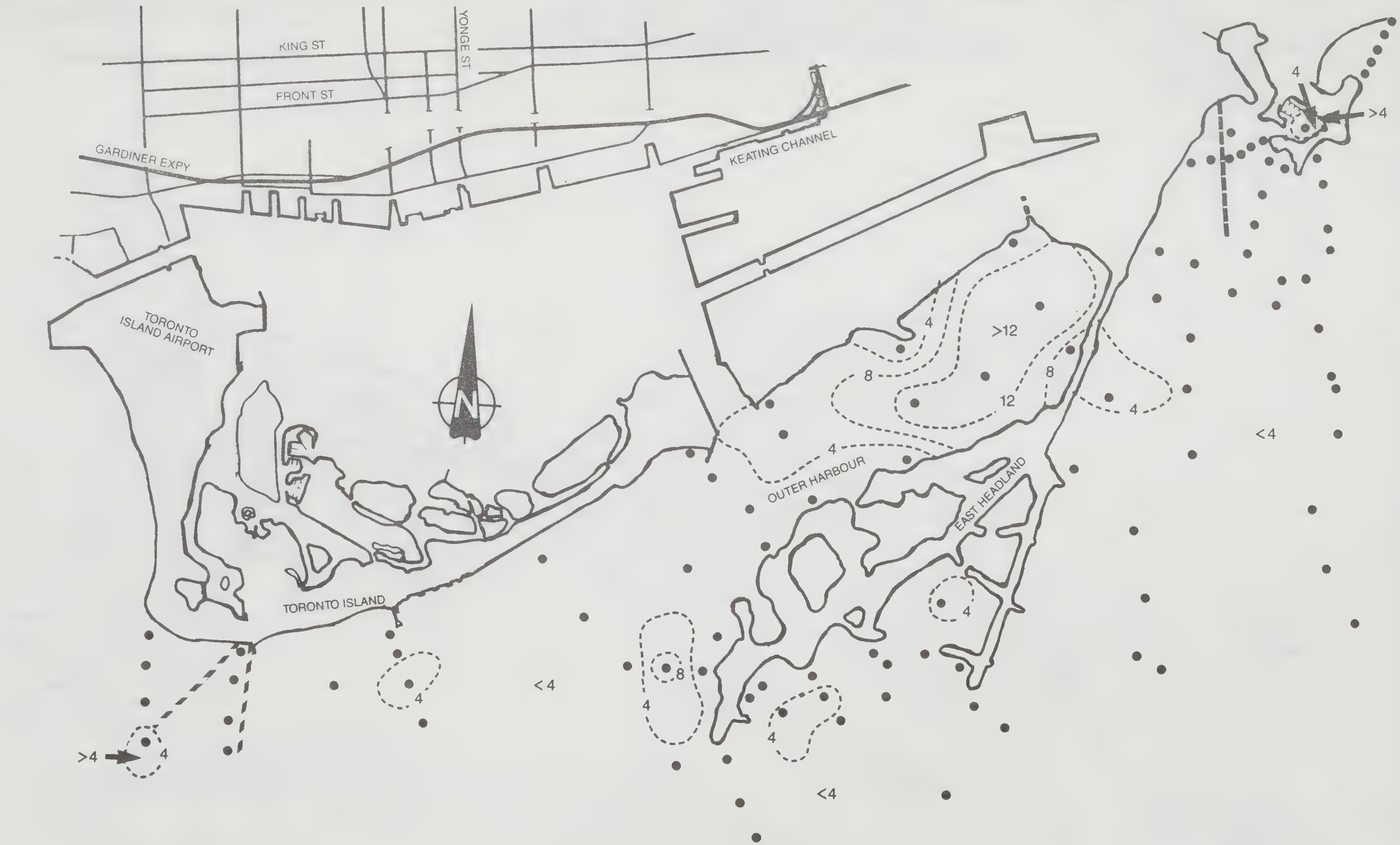



**FIGURE A.2-10**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(ZINC (ug/g)—MOE GUIDELINE IS 100 ug/g)**

Ministry of the Environment
Ontario




5 0 1 KILOMETRES

5 0 5 MILES

**FIGURE A.2-11**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(ARSENIC (ug/g)—MOE GUIDELINE IS 8.0 ug/g)**

Ministry of the Environment
Ontario

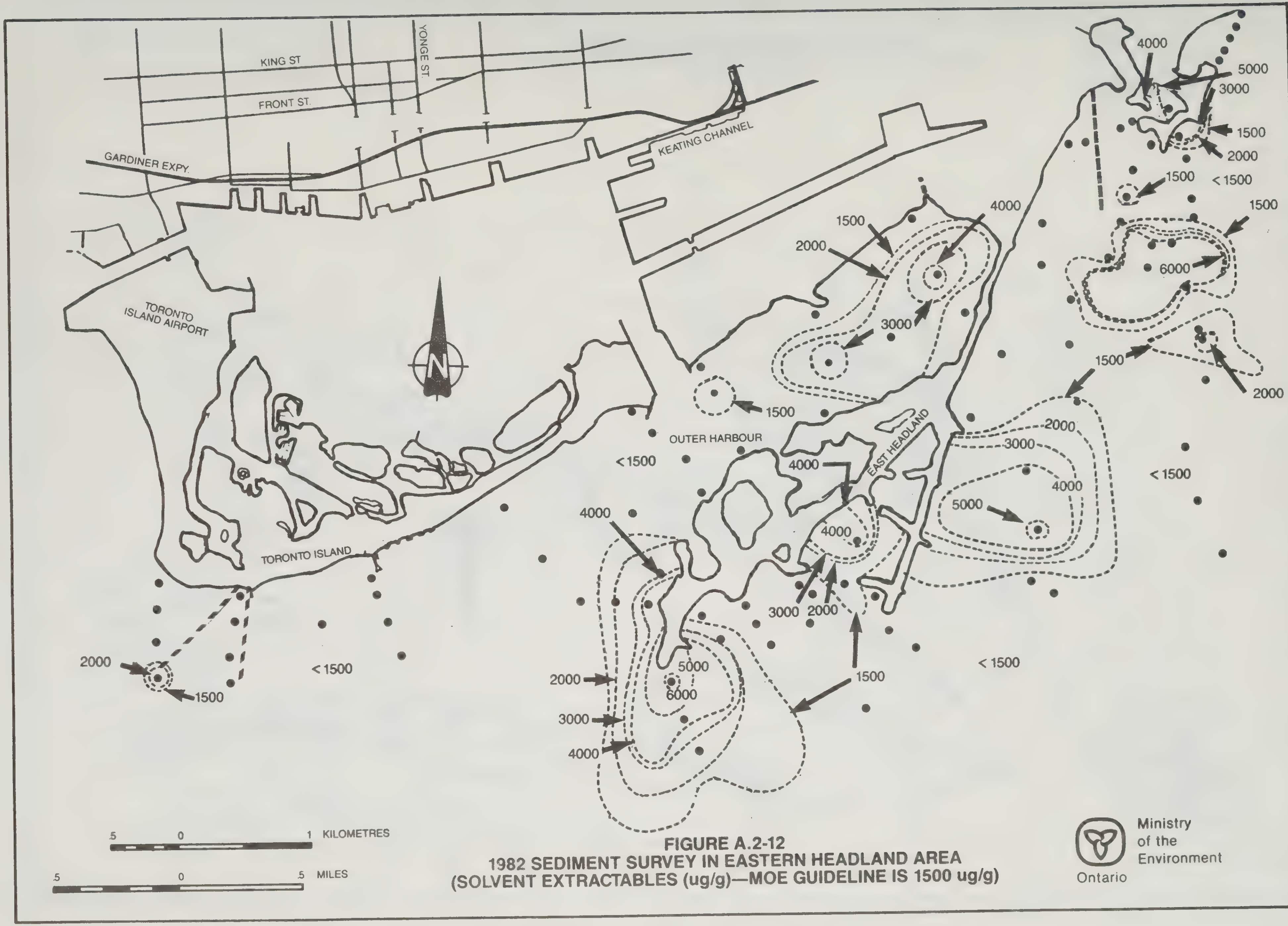



FIGURE A.2-12
1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA
(SOLVENT EXTRACTABLES (ug/g)—MOE GUIDELINE IS 1500 ug/g)


**FIGURE A.2-13**
**1982 SEDIMENT SURVEY IN EASTERN HEADLAND AREA**
**(PCB'S (ng/g)—MOE GUIDELINE IS 50 ng/g)**

FIGURES (A.3-1) - (A.3-13)

PLEASE REFER TO SECTION 3 OF THE MAIN REPORT
FOR THE STATION LOCATIONS

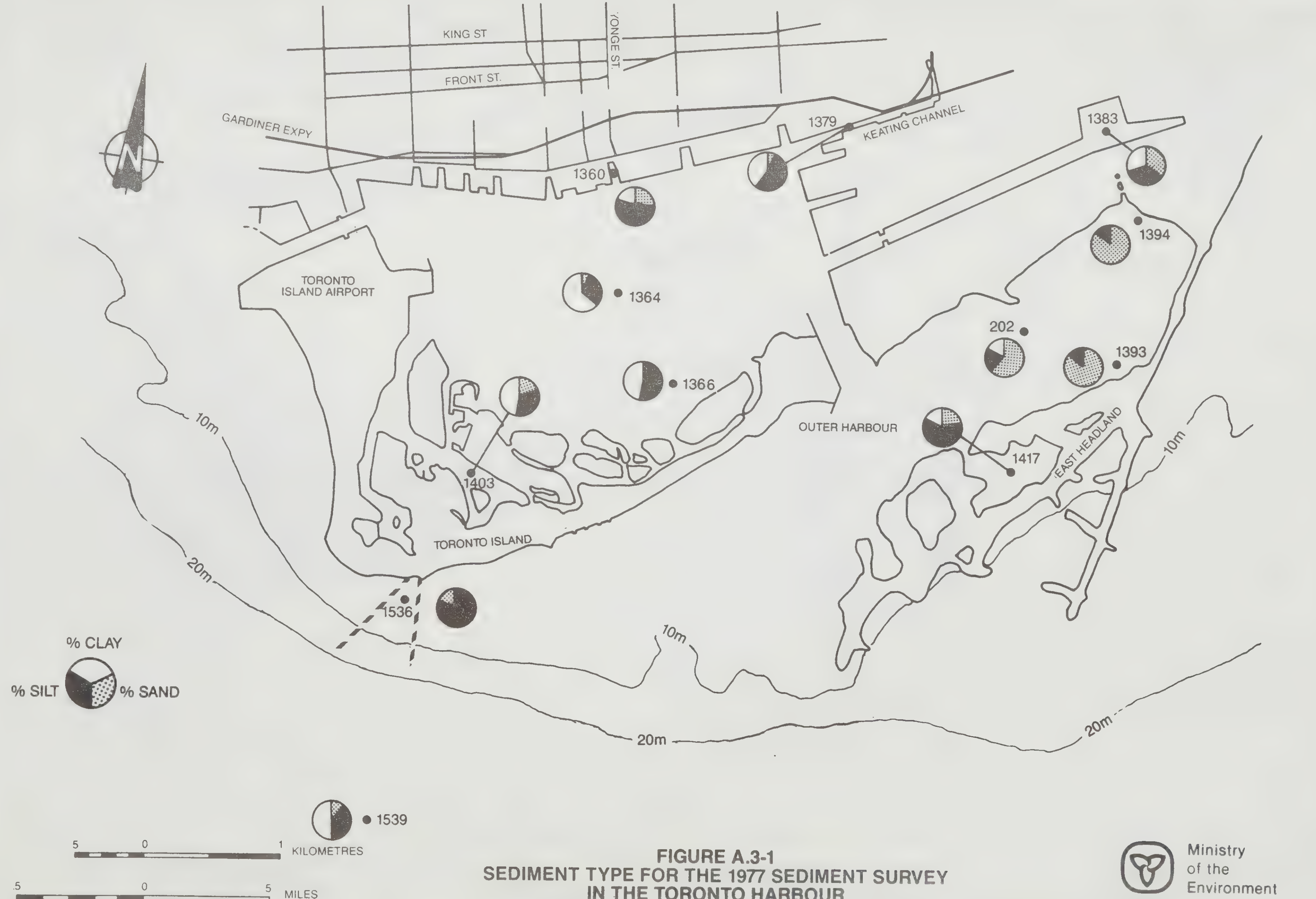



**FIGURE A.3-1**
**SEDIMENT TYPE FOR THE 1977 SEDIMENT SURVEY**
**IN THE TORONTO HARBOUR**

Ministry of the Environment
Ontario

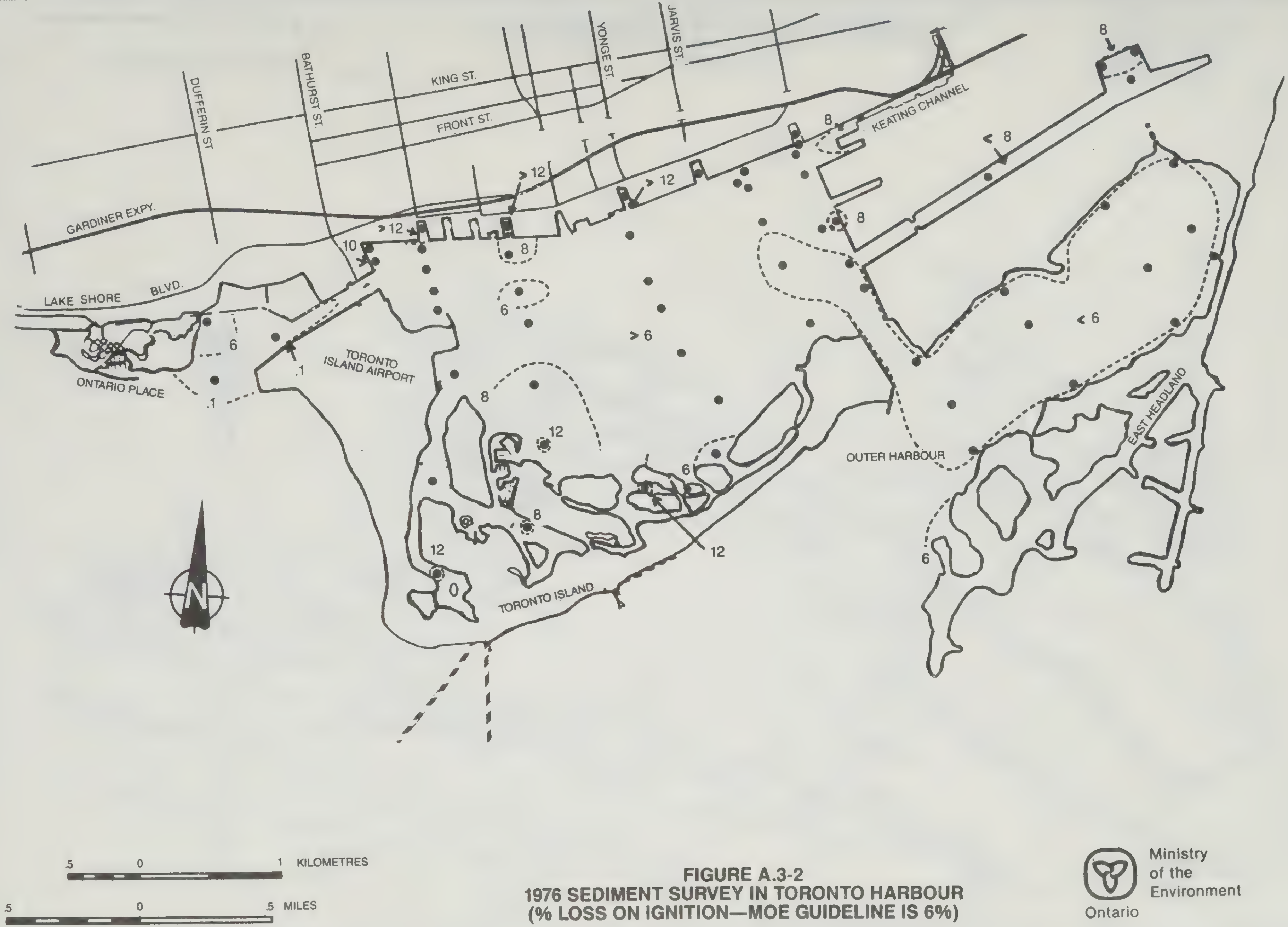



**FIGURE A.3-2**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(% LOSS ON IGNITION—MOE GUIDELINE IS 6%)**

Ministry of the Environment
Ontario

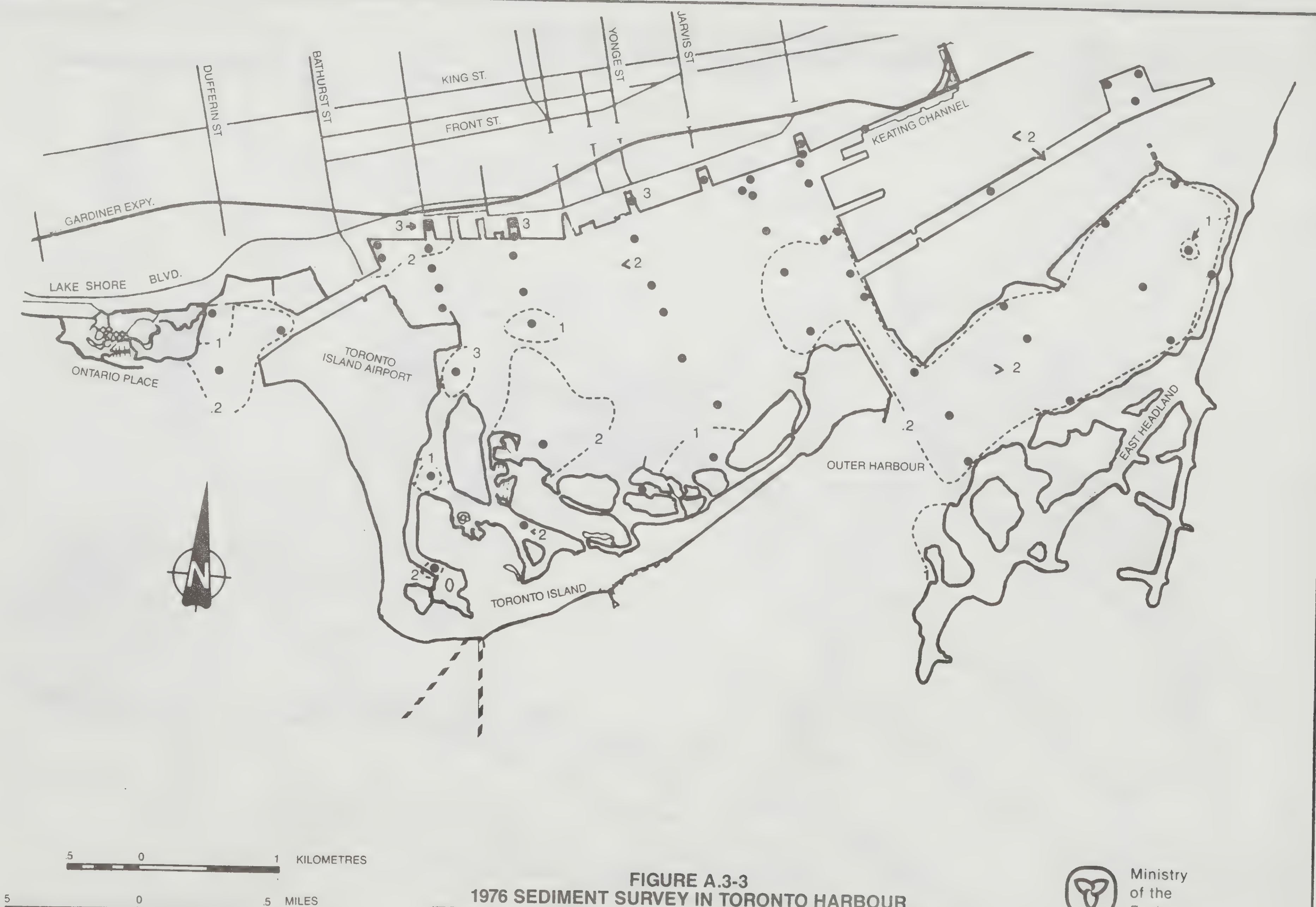



FIGURE A.3-3
1976 SEDIMENT SURVEY IN TORONTO HARBOUR
(TOTAL PHOSPHORUS (mg/g)—MOE GUIDELINE IS 1 mg/g)

Ministry of the Environment
Ontario

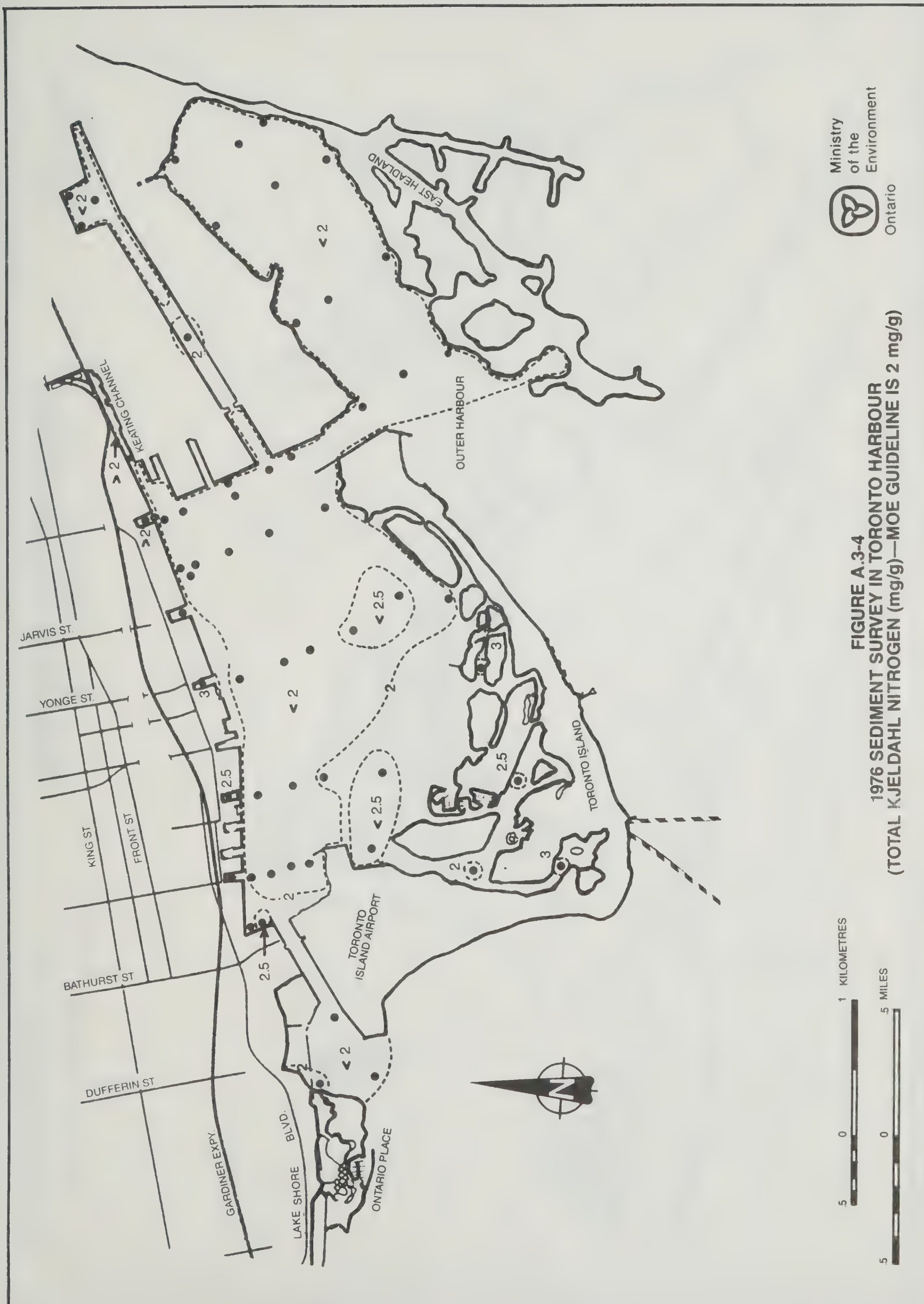



FIGURE A.3-4
1976 SEDIMENT SURVEY IN TORONTO HARBOUR
(TOTAL KJELDAHL NITROGEN (mg/g)—MOE GUIDELINE IS 2 mg/g)


FIGURE A.3-5
1976 SEDIMENT SURVEY IN TORONTO HARBOUR
(COPPER (ug/g)—MOE GUIDELINE IS 25 ug/g)

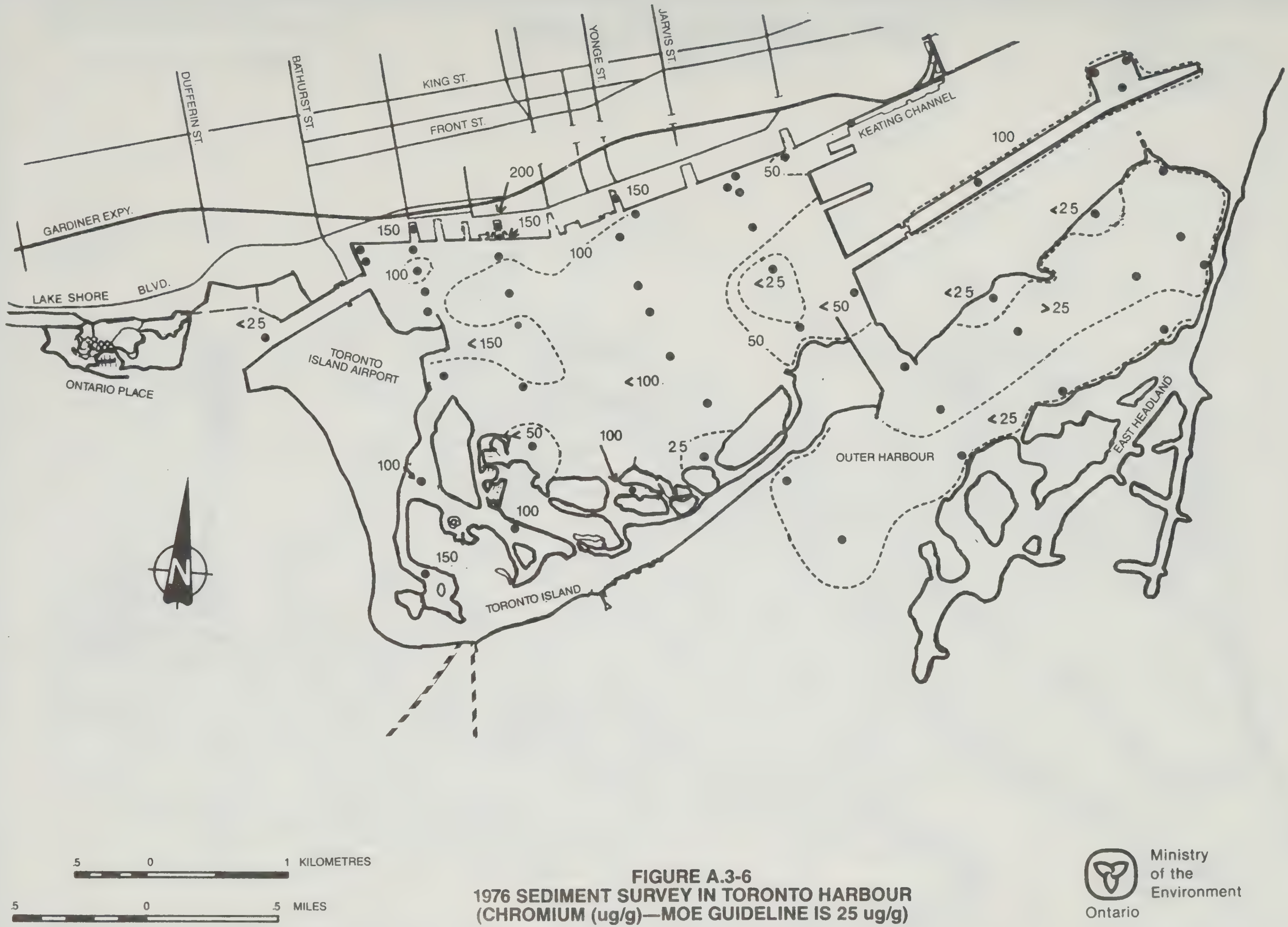



**FIGURE A.3-6**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(CHROMIUM (ug/g)—MOE GUIDELINE IS 25 ug/g)**

Ministry of the Environment
Ontario

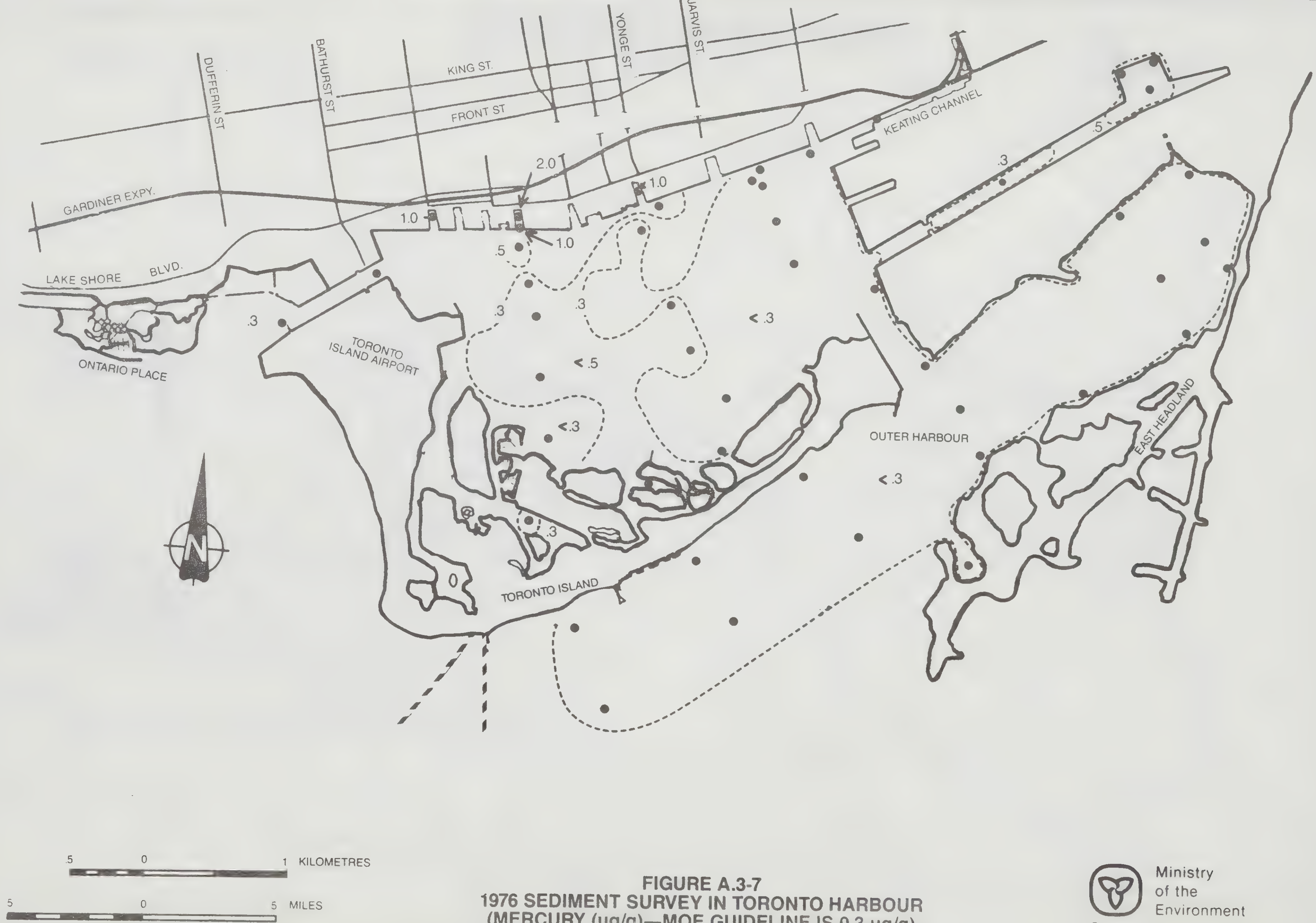



**FIGURE A.3-7**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(MERCURY (ug/g)—MOE GUIDELINE IS 0.3 ug/g)**

Ministry of the Environment
Ontario

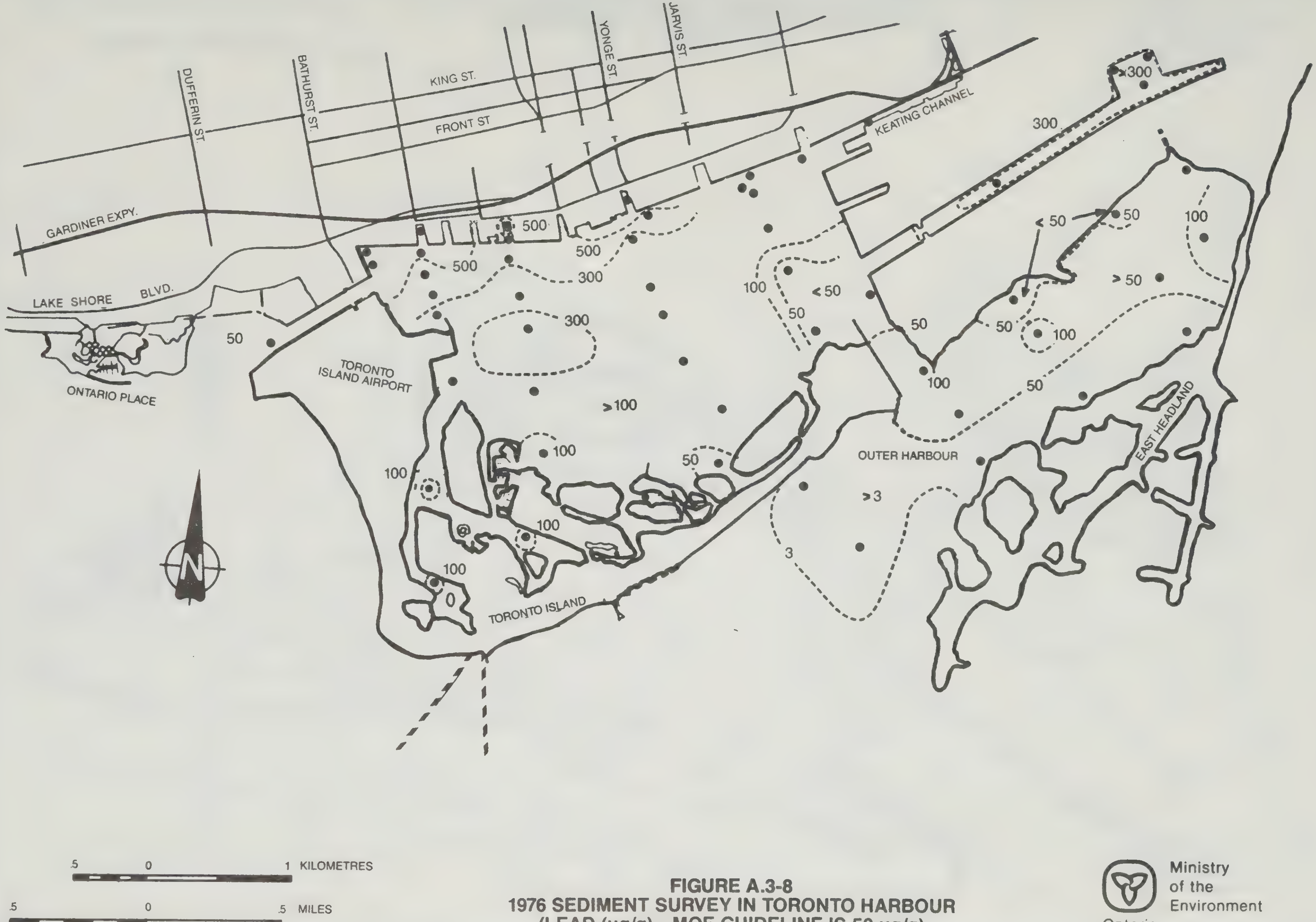



**FIGURE A.3-8**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(LEAD (ug/g)—MOE GUIDELINE IS 50 ug/g)**

Ministry
of the
Environment
Ontario

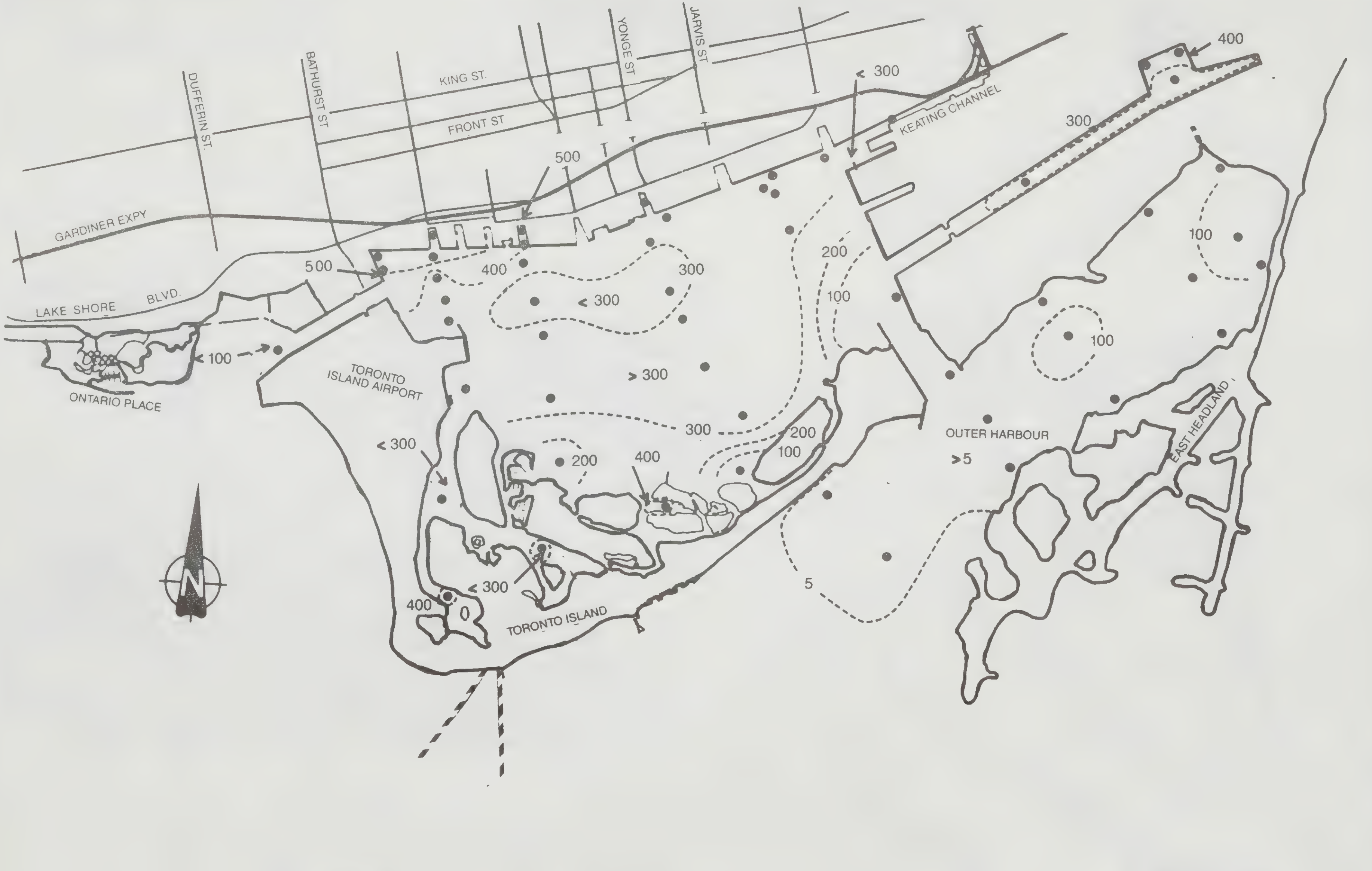



FIGURE A.3-9
1976 SEDIMENT SURVEY IN TORONTO HARBOUR
(ZINC (ug/g)—MOE GUIDELINE IS 100 ug/g)

Ministry of the Environment
Ontario


.5 0 1 KILOMETRES

.5 0 .5 MILES

**FIGURE A.3-10**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(NICKEL (ug/g)—MOE GUIDELINE IS 25 ug/g)**

Ministry of the Environment
Ontario



**FIGURE A.3-11**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(SOLVENT EXTRACTABLES (ug/g)—MOE GUIDELINE IS 1500 ug/g)**

Ministry of the Environment
Ontario

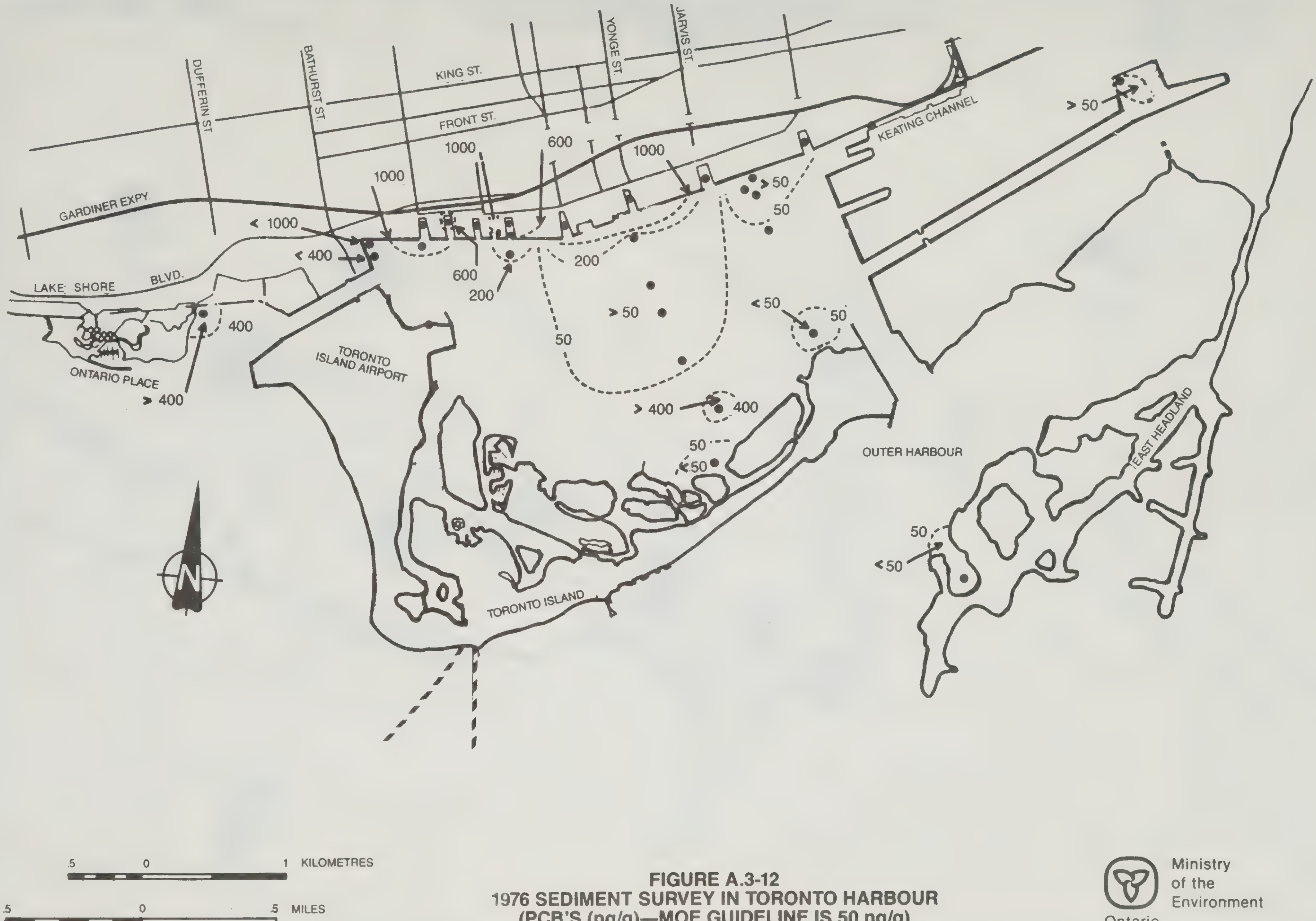



**FIGURE A.3-12**
**1976 SEDIMENT SURVEY IN TORONTO HARBOUR**
**(PCB'S (ng/g)—MOE GUIDELINE IS 50 ng/g)**

Ministry of the Environment
Ontario

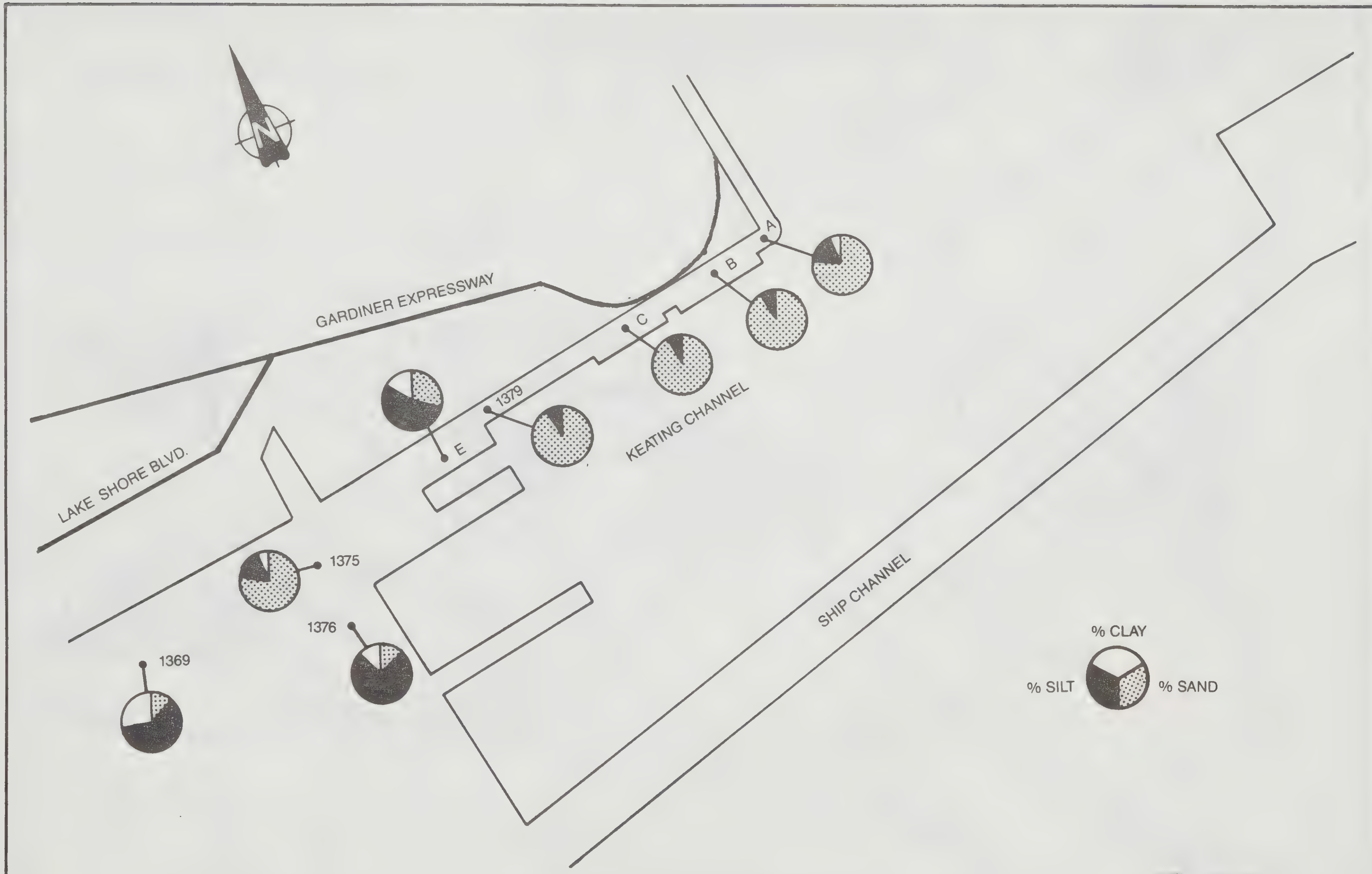



**FIGURE A.3-13**
**SEDIMENT TYPE FOR THE 1980 SEDIMENT SURVEY IN KEATING CHANNEL AREA**

Ministry of the Environment
Ontario

FIGURE A 4

PLEASE REFER TO SECTION 3 OF THE MAIN REPORT
FOR THE STATION LOCATIONS

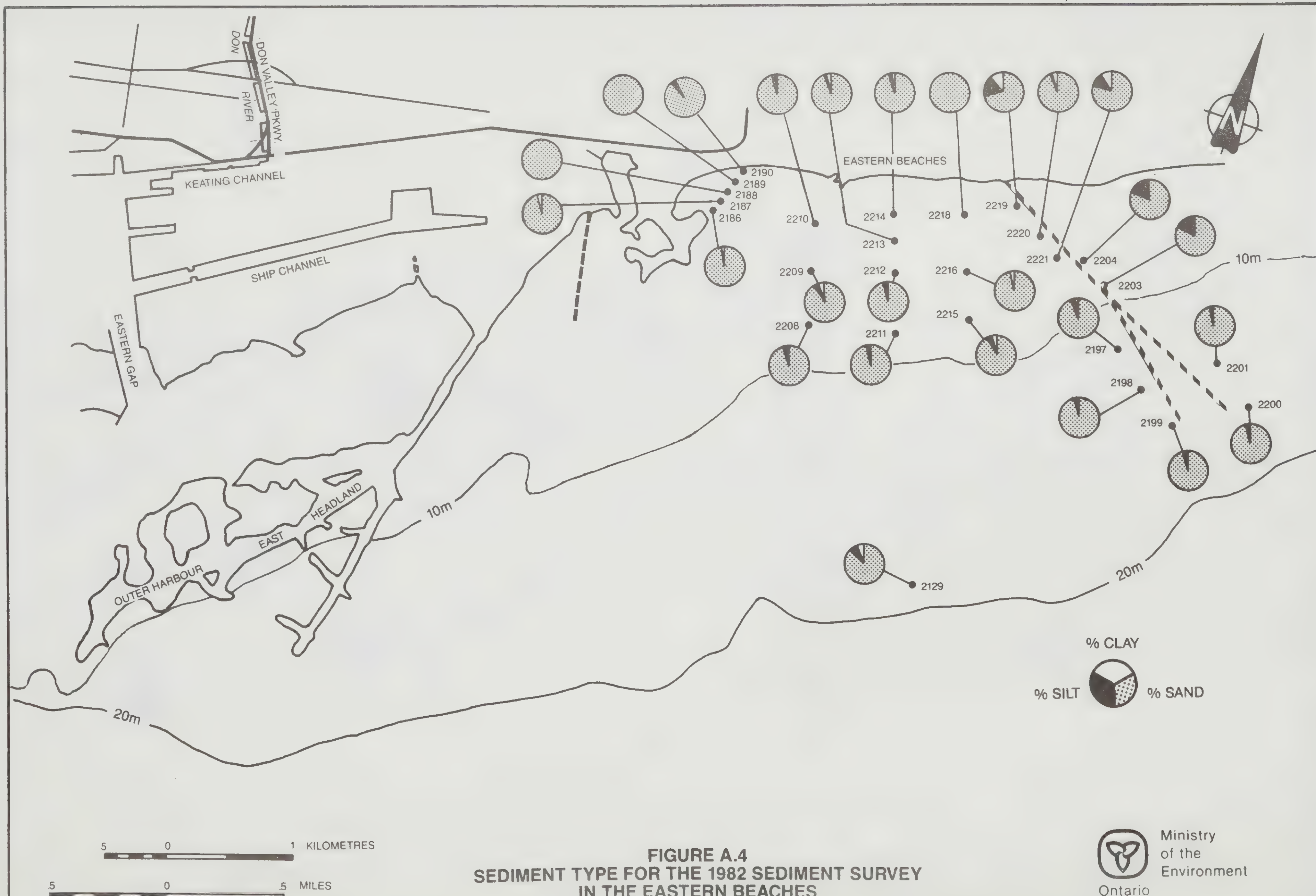



**FIGURE A.4**
**SEDIMENT TYPE FOR THE 1982 SEDIMENT SURVEY IN THE EASTERN BEACHES**

Ministry of the Environment
Ontario

TABLES A1 - A10

PLEASE REFER TO SECTION 3 OF THE MAIN REPORT
FOR THE STATION LOCATIONS

Table A.1 1979 Humber Bay Sediment Survey

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TP mg/g | TKN mg/g | TOC mg/g | Total PCB ng/g | Hg ug/g | Cd ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 323 | 29.7 | 8.3 | - | 3.0 | 1.30* | 0.93 | 1.3 | - | 0.12 | 1.10* | 80* | 40* | 12 | 170* | - |
| 327 | 82.1 | 4.0 | - | 3.0 | 0.51 | 0.37 | 3.6 | Nd | 0.09 | 0.68 | 18 | 9 | 22 | 51 | 670 |
| 328 | 92.5 | 4.7 | - | <1.0 | 0.25 | 0.16 | 23.0* | 33 | 0.33* | 0.45 | 12 | 6 | 11 | 27 | 357 |
| 330 | 10.8 | 75.2 | 14.0 | 5.0 | 1.59* | 2.09* | 23.0* | 590* | 0.30* | 4.30* | 130* | 80* | 130* | 280* | 3820* |
| 331 | 13.9 | 75.1 | 11.0 | 8.1* | 2.42* | 2.21* | 20.0* | 340* | 0.45* | 5.90* | 170* | 88* | 160* | 370* | 6000* |
| 332 | 7.1 | 78.0 | 15.0 | 8.2* | 3.70* | 5.12* | 29.0* | 700* | 0.32* | 9.60* | 240* | 110* | 160* | 530* | 13415* |
| 333 | 94.8 | 2.7 | - | <1.0 | 0.28 | 0.12 | 3.6 | - | <0.01 | <0.30 | 3 | 3 | 6 | 17 | 150 |
| 334 | 14.41 | 79.7 | 6.0 | 3.0 | 1.29* | 1.14 | 14.0* | Nd | 0.19 | 2.20* | 53* | 39* | 51* | 130* | 2233* |
| 335 | 1.7 | 89.6 | 8.7 | 7.2* | 4.14* | 3.27* | 31.0* | 690* | 0.75* | 10.00* | 380* | 140* | 280* | 670* | 3550* |
| 336 | 10.2 | 84.9 | 4.9 | 3.4 | 1.19* | 1.43 | 9.4 | 440* | 0.19 | 1.30* | 53* | 41* | 51* | 120* | 1320* |
| 337 | 9.0 | 85.6 | 5.4 | 3.7 | 1.28* | 1.38 | 18.0* | 1330* | 0.30* | 2.60* | 78* | 57* | 100* | 160* | 2367* |
| 338 | 93.6 | 6.4 | - | <1.0 | 0.94 | 0.17 | 1.9 | 110* | 0.12 | 0.60 | 18 | 16 | 52* | 55 | 980 |
| 339 | 41.4 | 34.4 | - | 2.1 | 0.73 | 0.29 | <0.1 | 30 | 0.02 | 0.04 | 16 | 8 | 14 | 28 | 377 |
| 340 | 15.2 | 85.6 | - | 3.7 | 1.06* | 1.30 | 4.2 | 410* | 0.25 | 1.80* | 83* | 45* | 98* | 150* | 2150* |
| 341 | 7.3 | 80.4 | 12.3 | 3.8 | 1.20* | 1.04 | 15.0* | 210* | 0.19 | 1.70* | 69* | 42* | 83* | 14 | 1700* |
| 342 | 67.3 | 27.9 | 4.8 | <1.0 | 0.94 | 0.27 | 2.0 | 110* | 0.06 | 0.80 | 15 | 12 | 56* | 55 | 865 |
| 343 | 95.9 | 4.8 | - | <1.0 | 0.41 | 0.13 | 2.1 | < 20 | 0.01 | 0.30 | 4 | 3 | 10 | 17 | 303 |
| 344 | 90.5 | 9.5 | - | <1.0 | 0.68 | 0.15 | 0.4 | Nd | 0.02 | 0.30 | 6 | 6 | 12 | 26 | 204 |
| 345 | - | - | - | 2.6 | 1.06* | 1.12 | 2.1 | 150* | 0.17 | 0.70 | 34* | 27* | 30 | 70 | 1350 |
| 346 | 95.4 | 3.8 | - | <1.0 | 0.56 | 0.14* | 2.1 | Nd | 0.84* | 0.30 | 4 | 4 | 11 | 21 | 158 |
| 347 | 10.9 | 77.1 | 12.0 | 7.1* | 7.44* | 6.65* | 31.0* | 410* | 1.20* | 22.00* | 665* | 265* | 520* | 1225* | 16440* |
| 348 | 51.5 | 31.9 | 10.6 | 1.4 | 0.77 | 0.61 | 1.9 | 65* | 0.08 | 0.40 | 19 | 12 | 15 | 43 | 436 |
| 349 | - | - | - | 4.6 | 1.29* | 2.10* | 16.0* | - | 0.46* | 2.30* | 80* | 55* | 100* | 200* | 3336* |
| 350 | - | - | - | 5.1 | 1.33* | 2.35* | 15.0* | - | 0.29 | 1.60* | 74* | 49* | 95* | 180* | 2413* |
| MOE Guidelines | | | | 6.0 | 1.0 | 2.0 | 10.0** | 50 | 0.30 | 1.00 | 25 | 25 | 50 | 100 | 1500 |

* Equals or exceeds MOE Guidelines.
ND Not detected.
\- No data.
** Interim Guideline.

Table A.1 1979 Humber Bay Sediment Survey - continued

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TP mg/g | TKN mg/g | TOC mg/g | Total PCB ng/g | Hg ug/g | Cd ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 352 | 43.2 | 49.3 | 6.6 | 1.8 | 0.59 | 0.67 | 6.6 | - | 0.06 | 0.40 | 19 | 12 | 16 | 42 | - |
| 353 | 6.1 | 86.3 | 7.6 | 4.0 | 1.03* | 1.52 | 14.7* | 310* | 0.38* | 1.70* | 64* | 43* | 83* | 140* | 1813* |
| 354 | 26.3 | 57.3 | 16.4 | 2.4 | 0.87 | 0.75 | 13.1* | 230* | 0.11 | 0.55 | 28* | 15 | 20 | 58 | 427 |
| 355 | 3.3 | 88.6 | 8.1 | 5.0 | 1.06* | 1.57 | 28.0* | 410* | 0.40* | 1.60* | 72* | 44* | 99* | 150* | 2175* |
| 356 | 2.0 | 74.6 | 23.4 | 5.7 | 1.21* | 2.34* | 5.4 | 250* | 0.30* | 1.30* | 73* | 47* | 83* | 160* | 2260* |
| 357 | 5.0 | 91.4 | 3.6 | 3.6 | 1.07* | 1.72 | 15.0* | 150* | 0.38* | 1.70* | 62* | 45* | 89* | 130* | 2099* |
| 358 | 8.9 | 80.8 | 10.3 | 7.2* | 1.33* | 3.33* | 29.7* | 200* | 0.54* | 2.40* | 86* | 66* | 110* | 210* | 3745* |
| 359 | 1.5 | 84.9 | 13.6 | 5.6 | 2.39* | 1.24 | 13.6* | 400* | 0.27 | 1.50* | 66* | 45* | 80* | 150* | 450 |
| 360 | 2.3 | 13.5 | 24.2 | 5.2 | 1.27* | 2.18* | 18.0* | 400* | 0.28 | 1.50* | 70* | 45* | 81* | 160* | 1175* |
| 361 | 4.3 | 68.1 | 27.6 | 4.5 | 1.21* | 1.90 | 22.3* | 220* | 0.29 | 1.60* | 67* | 44* | 75* | 140* | 1900* |
| 362 | 4.2 | 73.6 | 22.2 | 3.4 | 1.12* | 1.33 | 13.1* | 170* | 0.25 | 1.50* | 66* | 37* | 68* | 140* | 2850* |
| 363 | 2.3 | 60.7 | 37.0 | 4.9 | 1.20* | 2.16* | 20.7* | 220* | 0.30* | 1.40* | 70* | 44* | 75* | 140* | 1800* |
| 364 | 2.4 | 57.9 | 39.7 | 5.4 | 1.28* | 2.51* | 25.0* | 130* | 0.32* | 1.40* | 64* | 42* | 73* | 150* | 1777* |
| 365 | 3.4 | 65.4 | 31.2 | 5.2 | 1.25* | 2.54* | 12.6* | 65* | 0.32* | 1.30* | 68* | 47* | 75* | 150* | 1418 |
| 366 | 2.4 | 51.6 | 46.0 | 5.1 | 1.26* | 2.39* | 18.8* | 180* | 0.54* | 2.10* | 81* | 54* | 98* | 170* | 2000* |
| 367 | 24.4 | 63.6 | 12.0 | 5.1 | 1.15* | 1.92 | 22.0* | 420* | 0.31* | 2.00* | 80* | 51 | 99* | 190* | 2300* |
| MOE Guidelines | | | | 6.0 | 1.0 | 2.0 | 10.0** | 50 | 0.30 | 1.00 | 25 | 25 | 50 | 100 | 1500 |

* Equals or exceeds MOE Guidelines.
ND Not detected.
\- No data.
** Interim Guideline

Table A.2 1982 Lake Ontario Sediment Survey - Extensive Study

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TP mg/g | TKN mg/g | TOC mg/g | Total PCB ng/g | As ug/g | Hg ug/g | Cd ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables- ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2135 | 53.7 | 38.8 | 7.5 | 1.4 | 1.8* | 2.1* | 5.6 | <20 | 3.75 | 0.06 | 0.70 | 28.0* | 43.0* | 35.0 | 110.0* | 431 |
| 2111 | 37.5 | 33.2 | 29.2 | 3.9 | 0.9 | 0.7 | 17.0 | <20 | 5.96 | 0.19 | 2.20* | 78.0* | 85.0* | 50.0* | 190.0* | 1968* |
| 2112 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 196 |
| 2113 | 65.2 | 22.9 | 11.8 | 2.6 | 0.9 | 1.3 | 12.0 | <20 | 4.82 | 0.10 | 1.80* | 36.0* | 76.0* | 92.0* | 150.0* | 3020* |
| 2114 | 31.5 | 49.6 | 18.5 | 3.4 | 1.4* | 1.4 | 17.0 | 55* | 2.62 | 0.16 | 2.90* | 73.0* | 61.0* | 89.0* | 190.0* | 7845* |
| 2115 | 73.1 | 8.9 | 15.5 | 3.2 | 0.6 | 0.5 | 14.0 | - | 2.62 | 0.17 | 2.80* | 64.0* | 41.0* | 28.0 | 160.0* | 20750* |
| 2116 | 22.1 | 50.5 | 27.1 | 5.2 | 2.4* | 3.5* | 22.0 | 30 | 4.29 | 0.22 | 3.2* | 78.0* | 62.0* | 64.0* | 230.0* | 10430* |
| 2117 | 34.3 | 36.7 | 29.0 | 6.8* | 3.8* | 3.1* | 30.0 | 50* | 6.81 | 0.36* | 11.0* | 230.0* | 130.0* | 150.0* | 580.0* | 5456* |
| 2118 | 21.7 | 34.6 | 43.1 | 4.3 | 1.4* | 1.5 | 18.0 | - | 1.39 | 0.36* | 3.1* | 84.0* | 64.0* | 100.0* | 220.0* | 3704* |
| 2119 | 29.9 | 46.4 | 33.6 | 3.7 | 1.2* | 1.4 | 15.0 | 130* | 4.29 | 0.16 | 1.7* | 68.0* | 51.0* | 66.0* | 150.0* | 1961* |
| 2120 | - | - | - | 3.9 | 0.5 | 0.1 | 0.0 | - | 1.32 | <0.01 | <0.20 | 4.60 | 5.1 | 4.6 | 13.0 | 124 |
| 2121 | 66.8 | 25.5 | 5.4 | 0.9 | 0.7 | 0.3 | 30.0 | 30 | 1.68 | 0.02 | 0.30 | 30.0* | 34.0* | 22.0 | 30.0 | 4500* |
| 2122 | 84.4 | 10.6 | 4.0 | 0.9 | 0.7 | 0.4 | 3.4 | <20 | 1.75 | 0.06 | <0.20 | 28.0* | 19.0 | 30.0 | 73.0 | 680 |
| 2123 | 89.7 | 3.5 | 3.5 | <1.0 | 0.4 | 0.3 | 1.8 | <20 | 2.05 | <0.01 | <0.20 | 6.8 | 7.6 | 7.3 | 25.0 | 430 |
| 2124 | 18.8 | 35.5 | 45.6 | 3.7 | 0.9 | 0.8 | 12.0 | 50* | 4.86 | 0.19 | 0.40 | 11.0 | 10.0 | 82.0* | 120.0* | 4090* |
| 2125 | 82.3 | 13.2 | 4.4 | 0.5 | 1.0* | 0.4 | 1.5 | <20 | 1.43 | 0.02 | <0.20 | 13.0 | 9.0 | 6.8 | 27.0 | 1040 |
| 2126 | 63.0 | 33.3 | 2.8 | 0.8 | 1.4* | 0.6 | 3.8 | <20 | 1.11 | 0.05 | <0.20 | 20.0 | 17.0 | 27.0 | 36.0 | 850 |
| 2127 | 6.6 | 45.4 | 48.0 | 5.4 | 2.8* | 2.3* | 24.0 | 95* | 5.45 | 0.35* | 3.30* | 180.0* | 130.0* | 140.0* | 250.0* | 5350* |
| 2128 | 77.2 | 13.7 | 9.0 | 1.5 | 0.7 | 0.7 | 6.8 | <20 | 1.84 | 0.04 | <0.20 | 23.0 | 21.0 | 16.0 | 47.0 | 3510* |
| 2129 | 88.8 | 1.2 | 2.8 | 0.8 | 0.3 | 0.3 | 3.6 | <20 | 1.69 | <0.01 | <0.20 | 6.9 | 10.0 | 3.0 | 20.0 | 210 |
| 2130 | 86.3 | 8.5 | 0.9 | 0.3 | 2.0 | 0.1 | 0.0 | <20 | 1.28 | <0.01 | <0.20 | 9.8 | 4.8 | 4.8 | 18.0 | 490 |
| 2131 | 73.8 | 19.5 | 6.6 | 0.8 | 1.1* | 0.3 | 2.1 | <20 | 1.43 | <0.01 | <0.20 | 11.0 | 8.6 | 5.0 | 25.0 | 250 |
| 2132 | 82.6 | 2.0 | 3.3 | <1.0 | 0.5 | 0.3 | 1.5 | <20 | 2.41 | <0.01 | <0.20 | 6.4 | 7.0 | 12.0 | 28.0 | 410 |
| 2133 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 430 |
| 2134 | 35.0 | 44.8 | 20.1 | 2.3 | 0.9 | 0.7 | 9.4 | - | 2.01 | 0.03 | 0.30 | 20.0 | 23.0 | 39.0 | 83.0 | 4400* |
| MOE Guidelines | | | | 6.0 | 1.0 | 2.0 | 10.0 | 50 | 8.0 | 0.30 | 1.00 | 25.0 | 25.0 | 50.0 | 100.0 | 1500 |

* Equals or exceeds MOE Guidelines.

ND Not detected.

\- No data.

Table A.3 1983 Humber Bay Beaches Sediment Survey (Inside Breakwall)

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TP mg/g | TKN mg/g | TOC mg/g | Cd ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g | PCB ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Humber A | 87.0 | 11.4 | 1.6 | 0.69 | 0.42 | ND | 5.1 | 0.50 | 9.0 | 8.0 | 12.0 | 37.0 | 600 | 25 |
| Humber B | 94.9 | 5.1 | 0.0 | 0.51 | 0.35 | ND | 2.4 | 0.40 | 6.5 | 5.5 | 8.0 | 25.0 | 150 | <20 |
| T1A | 92.9 | 6.0 | 1.1 | 0.51 | ND | 4.1 | - | <0.30 | 8.0 | 8.0 | 24.0 | 40.0 | 660 | <20 |
| T1B | 84.7 | 12.0 | 3.3 | 0.47 | 0.58 | 0.17 | 3.8 | <0.30 | 10.0 | 11.5 | 32.0 | 40.0 | 450 | <20 |
| T2A | 42.2 | 53.4 | 4.4 | 3.23 | 0.89 | 1.08 | 17.0* | 1.15* | 36.0* | 33.5* | 75.0* | 140.0* | 2410* | 60* |
| T2B | 55.7 | 40.5 | 3.8 | 2.49 | 0.90 | 0.70 | 17.0* | 1.27* | 38.0* | 33.0* | 86.0* | 159.0* | 2480* | 105* |
| T3A | 49.1 | 47.6 | 3.3 | 2.36 | 0.78 | 0.77 | 15.0* | 0.90 | 26.0* | 27.5* | 59.0* | 106.0* | 2090* | 60* |
| T3B | 13.6 | 80.4 | 6.0 | 5.08 | 1.25* | 1.87 | 24.0* | 2.30* | 68.0* | 56.5* | 127.0* | 244.0* | 2360* | 165* |
| T4B | 37.3 | 56.7 | 6.0 | 4.49 | 1.25* | 1.55 | 24.0* | 2.20* | 70.0* | 66.0* | 96.0* | 200.0* | 3610* | 120* |
| T5B | 23.6 | 70.4 | 6.1 | 3.93 | 1.23* | 1.53 | 22.0* | 2.00* | 60.0* | 46.0* | 95.0* | 209.0* | 2770* | 50* |
| T6B | 19.5 | 72.3 | 8.2 | 3.78 | 1.00* | 1.03 | 16.0* | 1.00* | 43.0* | 47.5* | 43.0 | 118.0* | 4100* | 25 |
| T7B | 93.2 | 5.8 | 1.0 | 0.33 | 0.55 | 0.21 | 4.7 | 0.45 | 9.5 | 28.0* | 17.0 | 59.0 | 960 | 60* |
| T8B | 49.1 | 44.5 | 6.6 | 3.84 | 1.07* | 1.50 | 19.0* | 1.90* | 58.0* | 41.0* | 83.0* | 166.0* | 2800* | 210* |
| T9A | 98.9 | 1.1 | 0.0 | 0.40 | 0.43 | ND | 1.2 | <0.30 | 4.0 | 2.5 | 4.0 | 11.0 | 100 | <20 |
| T9B | 98.2 | 1.8 | 0.0 | 0.80 | 0.33 | 0.17 | 5.2 | <0.30 | 6.5 | 6.0 | 4.0 | 20.0 | 480 | <20 |
| MOE Guide-lines | | | | 6.0 | 1.0 | 2.0 | 10.0** | 1.00 | 25.0 | 25.0 | 50.0 | 100.0 | 1500 | 50 |

* Equals or exceeds MOE Dredging Guidelines for Open Water Disposal.
ND Not detected.
\- No data.
** Interim Guideline.

Table A.4 1982 Toronto Island Sediment Survey

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TKN mg/g | TOC mg/g | TP mg/g | As ug/g | Cr ug/g | Cu ug/g | Hg ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g | Total PCB ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2222 | 7.4 | 53.0 | 39.7 | 4.4 | 1.98 | 16.00* | 1.76* | 5.09 | 6.7 | 54.0* | 0.13 | 70.0* | 140.0* | 2420* | 100* |
| 2223 | 97.1 | 2.0 | 0.0 | 0.48 | 0.10 | 1.00 | 0.34 | 1,67 | 5.2 | 3.0 | <0.01 | 3.0 | 22.0 | 260 | <20 |
| 2224 | 97.4 | 2.6 | 0.0 | 0.24 | 0.10 | 0.50 | 0.34 | 1.05 | 5.3 | 3.8 | <0.01 | 3.8 | 15.0 | 510 | <20 |
| 2225 | 94.4 | 2.6 | 2.9 | 0.37 | 0.11 | 0.97 | 0.54 | 1.76 | 65.0* | 4.6 | <0.01 | 11.0 | 22.0 | - | <20 |
| 2226 | 97.3 | 1.7 | 1.0 | 0.28 | 0.10 | 0.45 | 0.50 | 1.33 | 6.0 | 2.7 | <0.01 | 4.8 | 16.0 | 260 | 25 |
| 2227 | 94.3 | 5.7 | 3.9 | 0.32 | 0.12 | 0.55 | 0.45 | 1.05 | 7.7 | 4.5 | <0.01 | 8.2 | 23.0 | 370 | <20 |
| 2228 | 94.2 | 3.8 | 1.9 | 0.32 | 0.10 | 0.50 | 0.70 | 2.30 | 6.2 | 3.1 | <0.01 | 5.4 | 19.0 | 90 | <20 |
| 2229 | 96.9 | 1.2 | 1.9 | 0.24 | 0.12 | 0.50 | 0.73 | 2.16 | 7.0 | 2.3 | <0.01 | 3.5 | 16.0 | 190 | <20 |
| 2230 | 97.9 | 2.0 | 0.0 | 0.28 | 0.13 | 0.50 | 0.53 | 3.49 | 6.4 | 3.8 | <0.01 | 4.5 | 19.0 | 90 | <20 |
| 2231 | 98.7 | 1.2 | 0.0 | 0.28 | 0.12 | 0.50 | 0.43 | 6.65 | 5.7 | 2.2 | <0.01 | 3.2 | 15.0 | 320 | <20 |
| 2232 | 98.3 | 0.5 | 0.0 | 0.46 | 0.10 | 0.69 | 0.28 | 1.38 | 5.5 | 3.3 | <0.01 | 2.2 | 17.0 | 280 | <20 |
| 2233 | 96.3 | 2.7 | 0.0 | 0.30 | 0.15 | 0.50 | 0.94 | 1.11 | 4.8 | 2.5 | 0.01 | 1.8 | 13.0 | 370 | <20 |
| 2234 | 98.5 | 1.4 | 0.0 | 0.20 | 0.14 | 0.50 | 0.47 | 0.91 | 5.4 | 2.5 | 0.01 | 2.0 | 12.0 | 300 | <20 |
| 2235 | 98.9 | 0.1 | 1.0 | 0.21 | 0.13 | 0.50 | 0.51 | 1.39 | 19.0 | 3.2 | 0.01 | 2.0 | 14.0 | 310 | <20 |
| 2236 | 99.2 | 0.6 | 1.0 | 0.28 | 0.12 | 0.50 | 0.50 | 0.94 | 5.9 | 2.3 | 0.01 | 2.0 | 12.0 | 180 | <20 |
| 2237 | 97.0 | 0.1 | 2.9 | 0.32 | 0.15 | 0.76 | 0.61 | 0.72 | 5.3 | 2.6 | 0.01 | 2.5 | 16.0 | 380 | <20 |
| MOE Guidelines | | | | 6.0 | 2.0 | 10.0** | 1.0 | 8.0 | 25.0 | 25.0 | 0.30 | 50.0 | 100.0 | 1500 | 50 |

* Equals or exceeds MOE Guidelines.
ND Not detected.
\- No data.
** Interim Guideline.

Table A.5 Eastern Headland Sediment Survey

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TKN mg/g | TOC mg/g | TP mg/g | As ug/g | Cr ug/g | Cu ug/g | Hg ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g | Total PCB ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2183 | 89.9 | 9.1 | 1.0 | 0.4 | 0.1 | 0.84 | 0.9 | 1.00 | 7.0 | 4.1 | <0.01 | 8.8 | 15.0 | 190 | 25 |
| 2184 | 91.8 | 5.1 | 2.9 | 0.6 | 0.3 | 2.80 | 1.5* | 1.43 | 13.0 | 11.0 | 0.03 | 19.0 | 34.0 | 1580* | <20 |
| 2185 | 89.8 | 3.1 | 7.0 | 1.1 | 0.4 | 4.00 | 1.7* | 1.62 | 25.0* | 24.0 | 0.08 | 33.0 | 53.0 | 1070 | <20 |
| 2192 | 82.8 | 14.3 | 2.9 | 0.2 | 0.2 | 1.00 | 1.0* | 0.96 | 6.3 | 2.8 | <0.01 | 6.3 | 16.0 | 97560* | <20 |
| 2193 | 86.0 | 12.1 | 1.9 | 0.3 | 0.1 | 1.00 | 0.8 | 1.05 | 6.5 | 4.4 | <0.01 | 7.1 | 16.0 | 350 | <20 |
| 2194 | 83.1 | 16.9 | 3.9 | 1.1 | 0.3 | 4.70 | 0.7 | 3.57 | 10.0 | 24.0 | 0.02 | 32.0 | 40.0 | 180 | <20 |
| 2195 | 90.1 | 5.8 | 3.9 | 0.2 | 0.1 | 1.00 | 0.6 | 0.86 | 4.8 | 4.1 | <0.01 | 6.5 | 11.0 | 110 | <20 |
| 2196 | 96.0 | 4.0 | 0.0 | 0.2 | 0.1 | 1.0 | 0.8 | 1.00 | 8.3 | 2.5 | <0.01 | 5.7 | 12.0 | 60 | <20 |
| 2206 | 98.3 | 1.5 | 0.0 | 0.1 | 0.1 | 1.0 | 1.3* | 0.91 | 6.0 | 3.3 | <0.01 | 6.2 | 10.0 | 1620* | <20 |
| 2207 | 96.5 | 0.1 | 2.9 | 0.6 | 0.2 | 1.0 | 0.3 | 1.62 | 3.7 | 2.8 | <0.01 | 5.4 | 14.0 | 2590* | <20 |
| 2238 | - | - | - | 0.9 | 0.3 | 2.20 | 1.5* | 0.81 | 25.00* | 25.00* | <0.01 | 38.00 | 54.00 | 1440 | - |
| 2239 | - | - | - | 0.5 | 0.1 | 0.88 | 0.9 | 3.20 | 9.60 | 9.60 | 0.04 | 9.50 | 26.00 | 320 | <20 |
| 2240 | - | - | - | 0.4 | 0.1 | 0.92 | 0.6 | 0.99 | 5.30 | 2.90 | <0.01 | 3.50 | 17.00 | 470 | - |
| 2241 | - | - | - | 0.6 | 0.2 | 1.20 | 0.5 | 1.41 | 9.50 | 10.00 | <0.01 | 13.00 | 34.00 | 760 | <20 |
| 2242 | 0.0 | 97.0 | 3.0 | 6.5* | 2.7* | 25.00* | 1.6* | 1.27 | 71.00* | 57.00* | 0.13 | 44.00 | 120.00* | 2280* | - |
| 2243 | - | - | - | 0.5 | 0.1 | 1.60 | 0.5 | 4.80 | 15.00 | 20.00 | 0.02 | 85.00* | 88.00 | 1070 | - |
| 2244 | - | - | - | 0.5 | 0.1 | 1.40 | 0.6 | 4.01 | 8.20 | 11.00 | <0.01 | 65.00* | 36.00 | 550 | 35 |
| 2245 | - | - | - | 3.5 | 0.6 | 19.00* | 1.3* | 1.70 | 24.00 | 25.00* | 0.08 | 55.00* | 77.00 | 1510* | <20 |
| 2246 | - | - | - | 0.4 | 0.2 | 1.00 | 0.6 | 3.05 | 6.00 | 2.40 | <0.01 | 5.00 | 18.00 | 560 | - |
| 2247 | 61.0 | 39.0 | 0.0 | 1.7 | 0.5 | 9.10 | 0.8 | 1.41 | 18.00 | 17.00 | 0.05 | 40.00 | 55.00 | 4370* | <20 |
| 2248 | 73.0 | 27.0 | 0.0 | 1.0 | 0.4 | 4.10 | 0.6 | 2.19 | 11.00 | 7.60 | <0.01 | 11.00 | 31.00 | 540 | - |
| 2249 | - | - | - | 3.0 | 0.6 | 15.00* | 1.0* | 2.24 | 25.00* | 31.00* | 0.08 | 52.00* | 79.00 | 5390* | 5 |
| 2250 | 31.0 | 69.0 | 0.0 | 0.5 | 0.2 | 1.60 | 0.3 | 1.27 | 5.40 | 2.40 | <0.01 | 5.80 | 16.00 | 230 | - |
| MOE Guidelines | | | | 6.0 | 2.0 | 10.0** | 1.0 | 8.0 | 25.0 | 25.0 | 0.30 | 50 | 100.00 | 1500 | 50 |

* Equals or exceeds MOE Guidelines.
ND Not detected.
\- No data.
** Interim Guideline.

Table A.5 Cont'd Eastern Headland Sediment Survey

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TKN mg/g | TOC mg/g | TP mg/g | As ug/g | Cr ug/g | Cu ug/g | Hg ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g | Total PCB ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2251 | - | - | - | 3.0 | 0.5 | 25.00* | 0.8 | 1.65 | 16.00 | 46.00* | 0.10 | 53.00* | 74.00 | 760 | 70* |
| 2252 | 35.5 | 64.5 | 0.0 | 1.6 | 0.5 | 10.00* | 0.9 | 2.94 | 14.00 | 22.00 | 0.08 | 31.00 | 48.00 | 310 | - |
| 2253 | 77.5 | 22.5 | 0.0 | 1.8 | 0.3 | 7.40 | 0.6 | 2.79 | 17.00 | 14.00 | 0.02 | 22.00 | 46.00 | 1270 | - |
| 2254 | 0.0 | 91.5 | 8.5 | 3.0 | 0.6 | 7.30 | 0.8 | 2.99 | 21.00 | 17.00 | 0.33* | 47.00 | 51.00 | 260 | <20 |
| 2255 | - | - | - | 0.5 | 0.1 | 1.50 | 0.6 | 1.13 | 7.20 | 18.00 | <0.01 | 17.00 | 30.00 | 1060 | <20 |
| 2256 | - | - | - | 0.8 | 0.2 | 6.20 | 0.5 | 1.80 | 13.00 | 16.00 | 0.02 | 23.00 | 39.00 | 1109 | - |
| 2257 | 0.0 | 95.0 | 5.0 | 1.8 | 0.7 | 8.10 | 0.9 | 2.43 | 26.00* | 25.00* | 0.09 | 43.00 | 72.00 | 1500* | <20 |
| 2258 | 0.0 | 96.0 | 4.0 | 1.2 | 0.6 | 7.10 | 0.8 | 1.84 | 20.00 | 17.00 | 0.04 | 28.00 | 46.00 | 1200 | - |
| 2259 | 0.0 | 94.0 | 6.0 | 3.8 | 1.2 | 21.00* | 1.2* | 2.94 | 30.00* | 55.00* | 0.33* | 120.00* | 160.00* | 2110* | 25 |
| 2260 | 0.0 | 91.5 | 8.5 | 2.3 | 0.5 | 3.20 | 1.7* | 1.89 | 29.00* | 21.00 | <0.01 | 7.50 | 65.00 | 1540* | - |
| 2261 | 0.0 | 90.0 | 10.0 | 1.5 | 0.5 | 3.60 | 0.8 | 6.92 | 24.00 | 22.00 | <0.01 | 6.00 | 42.00 | 300 | <20 |
| 2262 | 28.0 | 72.0 | 0.0 | 0.8 | 0.3 | 2.90 | 0.6 | 3.25 | 12.00 | 10.00 | 0.02 | 15.00 | 32.00 | 780 | 20 |
| 2263 | 55.0 | 45.0 | 0.0 | 1.7 | 0.7 | 8.80 | 0.8 | 2.58 | 24.00 | 18.00 | 0.05 | 54.00* | 54.00 | 1090 | - |
| 2264 | - | - | - | 1.6 | 0.3 | 11.00* | 0.4 | 2.48 | 16.00 | 22.00 | 0.02 | 170.00* | 55.00 | - | - |
| 2265 | 51.0 | 49.0 | 0.0 | 0.8 | 0.1 | 3.40 | 0.4 | 4.40 | 11.00 | 16.00 | 0.05 | 94.00* | 44.00 | 2160* | 20 |
| 2266 | - | - | - | 1.2 | 0.2 | 7.00 | 0.5 | 2.09 | 12.00 | 18.00 | <0.01 | 10.00 | 31.00 | 15610* | - |
| 2267 | 75.0 | 25.0 | 0.0 | 0.5 | 0.2 | 4.10 | 0.6 | 2.74 | 9.90 | 18.00 | <0.01 | 29.00 | 68.00 | 3630* | 20 |
| 2268 | 71.5 | 28.5 | 0.0 | 1.5 | 0.6 | 8.10 | 0.8 | 1.89 | 16.00 | 12.00 | 0.02 | 18.00 | 44.00 | 1920* | - |
| 2269 | - | - | - | 1.2 | 0.1 | 3.80 | 0.2 | 2.09 | 11.00 | 19.00 | <0.01 | 93.00* | 23.00 | 2380* | - |
| 2270 | - | - | - | 0.7 | 0.1 | 2.80 | 0.5 | 9.40* | 7.40 | 8.50 | <0.01 | 21.00 | 80.00 | 2750* | 20 |
| 2271 | - | - | - | 1.0 | 0.1 | 2.20 | 0.4 | 1.84 | 9.10 | 11.00 | - | 4.00 | 20.00 | 760 | - |
| 2272 | 51.0 | 49.0 | 0.0 | 2.6 | 1.1 | 12.00* | 0.9 | 2.58 | 24.00 | 23.00 | 0.08 | 45.00 | 86.00 | 1240 | 35 |
| 2273 | 56.6 | 43.5 | 0.0 | 0.8 | 0.3 | 3.28 | 0.6 | 3.36 | 37.00* | 10.00 | <0.01 | 31.00 | 36.00 | 360 | - |
| MOE Guidelines | | | | 6.0 | 2.0 | 10.00** | 1.0 | 8.0 | 25.0 | 25.0 | 0.30 | 50 | 100.00 | 1500 | 50 |

* Equals or exceeds MOE Guidelines.
ND Not detected.
\- No data
** Interim Guideline.

Table A.5 Cont'd Eastern Headland Sediment Survey

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TKN mg/g | TOC mg/g | TP mg/g | As ug/g | Cr ug/g | Cu ug/g | Hg ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g | Total PCB ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2274 | - | - | - | 0.5 | 0.1 | 0.50 | 0.4 | 2.04 | 6.50 | 2.10 | <0.01 | 2.50 | 10.00 | 280 | - |
| 2275 | 57.0 | 43.0 | 0.0 | 0.8 | 0.3 | 3.80 | 0.7 | 1.04 | 14.00 | 9.00 | <0.01 | 19.00 | 43.00 | 670 | 25 |
| 2276 | - | - | - | 0.5 | 0.1 | 0.54 | 0.4 | 1.87 | 6.20 | 4.50 | <0.01 | 3.00 | 10.00 | 390 | - |
| 2277 | 24.0 | 76.0 | 0.0 | 4.6 | 1.5 | 19.00* | 1.2* | 7.34 | 59.00* | 55.00* | 0.14 | 140.00* | 210.00* | 2000* | 80* |
| 2278 | - | - | - | 0.7 | 0.1 | 0.84 | 0.5 | 6.33 | 7.70 | 10.00 | <0.01 | 11.00 | 29.00 | 190 | - |
| 2279 | - | - | - | 0.4 | 0.1 | 0.50 | 0.6 | 1.23 | 8.60 | 2.30 | <0.01 | 12.00 | 9.30 | 280 | - |
| 2280 | 11.0 | 89.0 | 0.0 | 6.2* | 1.9 | 34.00* | 1.4* | 15.23* | 75.00* | 79.00* | 0.26 | 180.00* | 260.00* | 3790* | 105* |
| 2281 | - | - | - | 0.5 | 0.1 | 0.50 | 0.3 | 1.94 | 8.80 | 14.00 | <0.01 | 11.00 | 23.00 | 290 | - |
| 2282 | 11.0 | 89.0 | 0.0 | 1.8 | 0.3 | 2.70 | 0.8 | 4.17 | 32.00* | 28.00* | <0.01 | 38.00 | 64.00 | 330 | - |
| 2283 | 29.0 | 71.0 | 0.0 | 5.7 | 2.1* | 36.00* | 1.5* | 13.94* | 71.00* | 79.00* | 0.23 | 180.00* | 260.00* | 2850* | 70* |
| 2284 | 5.0 | 95.0 | 0.0 | 6.7* | 2.3* | 53.00* | 1.6* | 26.04* | 78.00* | 91.00* | 0.22 | 180.00* | 270.00* | 4190* | 85* |
| 2285 | - | - | - | 1.0 | 0.2 | 2.40 | 0.4 | 8.14* | 19.00 | 39.00* | 0.06 | 96.00 | 71.00 | 580 | - |
| 2286 | 74.1 | 18.3 | 7.4 | 0.3 | 0.2 | 1.00 | 1.1* | 1.05 | 12.0 | 14.0 | 0.04 | 21.0 | 27.0 | - | <20 |
| 2287 | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | <20 |
| 2288 | 69.6 | 24.4 | 5.8 | 0.4 | 0.2 | 1.00 | 0.9 | 1.14 | 8.9 | 6.6 | <0.01 | 6.8 | 21.0 | - | <20 |
| 2289 | 64.4 | 30.6 | 4.9 | 0.6 | 0.2 | 2.00 | 0.9 | 1.29 | 13.0 | 8.3 | 0.15 | 8.5 | 26.0 | 10 | <20 |
| 2290 | 83.8 | 11.2 | 4.9 | 0.4 | 0.2 | 1.30 | 0.9 | 1.05 | 31.0* | 7.7 | <0.01 | 5.0 | 24.0 | 1590* | <20 |
| 2291 | 81.5 | 11.2 | 7.6 | 0.8 | 0.4 | 3.30 | 1.2* | 1.29 | 19.0 | 14.0 | 0.04 | 16.0 | 36.0 | 580 | <20 |
| 2292 | 29.5 | 70.5 | 0.0 | 1.0 | 0.3 | 4.10 | 1.5* | 1.67 | 24.0 | 20.0 | 0.06 | 30.0 | 52.0 | - | 155* |
| 2293 | 90.8 | 7.1 | 2.0 | 0.3 | 0.1 | 0.50 | 1.6* | 1.91 | 7.9 | 8.0 | <0.01 | 42.0 | 32.0 | 1290 | <20 |
| 2294 | 72.0 | 28.0 | 1.9 | 0.5 | 0.3 | 1.00 | 1.4* | 0.86 | 13.0 | 11.0 | 0.02 | 22.0 | 25.0 | 420 | <20 |
| 2295 | 69.4 | 27.6 | 2.9 | 0.4 | 0.1 | 1.10 | 1.5* | 1.05 | 12.0 | 7.4 | 0.04 | 12.0 | 25.0 | - | <20 |
| 2296 | 68.7 | 28.4 | 2.8 | 0.5 | 0.1 | 1.40 | 1.3* | 1.24 | 11.0 | 9.4 | 0.02 | 17.0 | 24.0 | - | <20 |
| MOE Guidelines | | | | 6.0 | 2.0 | 10.0** | 1.0 | 8.0 | 25.0 | 25.0 | 0.30 | 50 | 100.00 | 1500 | 50 |

* Equals or exceeds MOE Guidelines.
ND Not detected.
\- No data.
** Interim Guideline.

Table A.6 1976 Toronto Harbour Sediment Survey

| Station Number | % Loss on Ignition | TP mg/g | TKN mg/g | Total PCB ng/g | Hg ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Ni ug/g | Solvent Extract-ables |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1399 | 7.6* | 2.0* | 2.2* | 550* | - | - | - | - | - | - | 4340* |
| 1400 | 0.58 | 0.5 | 0.2 | Nd | - | - | - | - | - | - | 4520* |
| 388 | 0.92 | 0.3 | 0.2 | - | 0.13 | 16 | 12 | 42 | 61 | 7 | 540 |
| 1345 | 7.0* | 1.7* | 1.6 | 965* | - | 110* | 120* | 710* | 590* | 35* | 7800* |
| 1346 | 11.0* | 2.2* | 2.9* | 185* | - | 100* | 160* | 1300* | 680* | 34* | 13600* |
| 1012 | - | - | - | Nd | - | - | - | - | - | - | - |
| 1347 | 14.0* | 3.4* | 2.3* | 4000* | 1.8 | 180* | 270* | 1600* | 960* | 42* | 3600* |
| 1348 | 8.6* | 2.2* | 1.9 | 2000* | - | 130* | 160* | 810* | 600* | 36* | 12400* |
| 1349 | 6.1* | 1.6* | 1.6 | Nd | - | 88* | 88* | 400* | 350* | 30* | 5800* |
| 1350 | 6.0* | 1.6* | 1.8 | Nd | - | 110* | 86* | 290* | 350* | 30* | 5200* |
| 1351 | 6.0* | 1.5* | 1.9 | Nd | - | 110* | 85* | 290* | 380* | 32* | 4800* |
| 1352 | 6.9* | 4.6* | 2.1* | Nd | - | 98* | 80* | 280* | 400* | 35* | 4420* |
| 1401 | 7.2* | 0.7 | 1.2 | Nd | - | 60* | 54* | 120* | 210* | 25* | - |
| 1402 | 12.0* | 2.2 | 3.8* | Nd | - | 150* | 110* | 220* | 360* | 39* | - |
| 1425 | - | - | - | 450* | - | - | - | - | - | - | 4400* |
| 1426 | - | - | - | 500* | - | - | - | - | - | - | 4200* |
| 1353 | 14.0* | 2.2* | 2.6* | 3200* | 3.4* | 320* | 320* | 1200* | 780* | 54* | 41000* |
| 1354 | 8.8* | 1.7* | 2.1* | 550* | 1.5* | 170* | 180* | 530* | 480* | 40* | 11380* |
| 1355 | 6.6* | 1.4* | 1.7 | 120* | 0.52* | 100* | 120* | 310* | 380* | - | 6850* |
| 1356 | 4.2 | 1.6* | 0.9 | Nd | 0.26 | 53* | 120* | 140* | 180* | 24 | 4500* |
| 1357 | 7.1* | 0.9 | 2.0* | Nd | 0.32* | 110* | 90* | 380* | 380* | 12 | 4900* |
| 1358 | 9.4* | - | 2.1* | Nd | 0.40* | 100* | 80* | 270* | 360* | 37* | - |
| 1359 | 13.0* | 2.4* | - | Nd | 0.16 | 30 | 26* | 75* | 130* | - | 910 |
| 1403 | 8.9* | 1.1* | 2.6* | Nd | 0.33* | 78* | 72* | 160* | 280* | 32* | - |
| 1397 | - | - | - | Nd | <0.01 | - | - | - | - | - | 185 |
| 1427 | - | - | - | 300* | - | - | - | - | - | - | 6000* |
| 1398 | - | - | - | Nd | 0.05 | - | - | - - | - | - | 288 |
| 1404 | 12.0* | 1.2* | 3.0* | Nd | 0.51* | 66* | 86* | 270* | 320* | 28* | 3300* |
| 1407 | - | - | - | Nd | <0.01 | - | - | - | - | - | 255 |
| 1408 | - | - | - | Nd | <0.01 | - | - | - | - | - | 244 |
| 1360 | 13.0* | 2.4* | 3.7* | 4450* | 1.8* | 190* | 860* | 1400* | 830* | 40* | 2500* |
| 1361 | - | - | - | Nd | 0.67* | 92* | 130* | 450* | 410* | 35* | 1100 |
| 1362 | 6.8* | 1.4* | 1.5 | 100* | 0.13 | 72* | 74* | 240* | 800* | 30* | 4400* |
| 1363 | 5.9 | 1.1* | 1.4 | 40 | - | 48* | 62* | 112* | 220* | 24 | 2970* |
| 1364 | 7.1* | 1.6* | 1.7 | 60* | 0.3* | 86* | 80* | 250* | 340* | 35* | 4200* |
| 1365 | 7.6* | 1.6* | 2.1* | 175* | 0.3* | 93* | 84* | 260* | 350* | 35* | 1600* |
| 1366 | 7.6* | 1.5* | 2.2* | 460* | 0.36* | 100* | 88* | 270* | 360* | 38* | 1500* |
| 1367 | 0.9 | 0.6 | 0.3 | < 20 | <0.01 | 5 | 3 | 13 | 22 | 4 | 260 |
| 1428 | 7.4* | 1.4* | 2.1* | 278* | - | - | - | - | - | - | 6100* |
| 1411 | - | - | - | Nd | 0.02 | 10 | 2 | 10 | 14 | 3 | 125 |
| 1412 | - | - | - | Nd | <0.01 | 4 | 2 | 3 | 13 | 3 | 162 |
| 1368 | 6.7* | 1.3* | 0.2 | 150* | 0.2 | 63* | 68* | 280* | 320* | 27* | 5200* |
| 1369 | 6.4* | 1.3* | 1.5 | 140* | 0.19 | 58* | 62* | 260* | 300* | 28* | 5900* |
| 1370 | 6.*4 | 1.3* | 1.4 | 110* | 0.22 | 63* | 58* | 210* | 290* | 28* | 3700* |
| 1371 | 6.9* | 1.3* | 1.7 | 40 | 0.22 | 74* | 64* | 220* | 300* | 30* | 4500* |
| 1372 | 6.5* | 1.3* | 1.8 | Nd | 0.26 | 82* | 66* | 220* | - | 31* | 3000* |
| 1373 | 1.3 | 0.42 | 0.2 | 25 | - | 9 | 6 | 17 | - | 5 | 260 |
| 1415 | - | - | - | < 20 | 0.06 | - | - | - | - | - | 1050 |

Table A.6 1976 Toronto Harbour Sediment Survey - cont'd

| Station Number | % Loss on Ignition | TP mg/g | TKN mg/g | Total PCB ng/g | Hg ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Ni ug/g | Solvent Extract-ables |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1429 | 7.2* | 1.1* | 2.1* | 200* | - | - | - | - | - | - | 5000* |
| 1374 | 7.4* | 1.1* | 2.1* | - | - | - | - | - | - | - | 6150* |
| 1375 | 6.6* | 1.2* | 1.4 | - | 0.23 | 47* | 52* | 220* | 330* | 22 | 4660* |
| 1376 | 7.5* | 1.2* | 1.8 | - | - | - | - | - | - | - | 3780* |
| 1377 | 6.5* | 1.2* | 1.8 | - | - | - | - | - | - | - | 3640* |
| 1380 | 9.5* | 0.8 | 1.8 | - | - | - | - | - | - | - | 5260* |
| 1378 | 4.8 | 0.7 | 0.9 | - | - | - | - | - | - | - | 520 |
| 1014 | 5.5 | 0.6 | 1.4 | - | 0.07 | 30* | 23 | 6 | 52 | 22 | 1300 |
| 359 | 3.9 | 0.9 | 1.2 | - | 0.18 | 51* | 40* | 110* | 50 | 19 | 1400 |
| 1386 | 3.2 | 0.8 | 0.9 | - | 0.12 | 29* | 36* | 58* | 92 | 17 | 530 |
| 1387 | 1.0 | 0.4 | 0.1 | - | <0.01 | 3 | 3 | 3 | 9 | 3 | 70 |
| 1379 | 9.6 | 1.1* | 2.0* | Nd | 0.16 | 47* | 45* | 180* | 230* | 28* | 4000* |
| 1381 | 7.4 | 1.6* | 2.3* | - | 0.36* | 84* | 76* | 240* | 340* | 38* | 940 |
| 1388 | 1.0 | 0.5 | 0.1 | - | - | 6 | 6 | 16 | 26 | 4 | 3940* |
| 1389 | 4.6 | 0.9 | 1.4 | - | - | 56* | 50* | 120* | 170* | 25* | 820 |
| 1390 | 0.1 | 0.2 | 0.1 | - | 0.1 | 4 | 2 | 3 | 5 | 3 | 70 |
| 1391 | 1.2 | 0.5 | 0.1 | - | 0.04 | 14 | 12* | 42 | 41 | 7 | 1150 |
| 1392 | 3.8 | 0.9 | 0.8 | - | 0.12 | 38* | 34* | 76* | 99 | 18 | 1400 |
| 1393 | 1.0 | 0.2 | 0.1 | - | 0.02 | 7 | 4 | 3 | 13 | 5 | 200 |
| 1394 | 8.3* | 1.3* | 1.8 | 180 | 0.56* | 86* | 90* | 440* | 420* | 21 | 8000* |
| 1385 | 9.3* | 1.6* | 2.0* | - | 0.91* | 100* | 100* | 450* | 430* | 22 | 6050* |
| 1383 | 7.7* | 1.3* | 1.8 - | - | 0.65* | 87* | 86* | 360* | 340* | 18 | 4260* |
| 1394 | 3.8 | 0.4 | 1.3 | - | 0.10 | 34* | 40* | 81* | 77 | 21 | 1500* |
| 1395 | 5.0 | 1.1* | 1.3 | - | 0.26 | 49* | 47* | 130* | 150* | 25* | 1450* |
| MOE Guide-lines | 6.0 | 1.0 | 2.0 | 50 | 0.30 | 25 | 25 | 50 | 100 | 25 | 1500 |

* Equals or exceeds MOE Guidelines.

ND not detected

\- no data

Table A.7 1977 Toronto Harbour Sediment Survey
(Depth 0-5.0 cm)

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | Hg ug/g | Pb ug/g | Zn ug/g |
|---|---|---|---|---|---|---|---|
| 1383 | 36.0 | 34.0 | 30.0 | 8.7* | 0.54* | 300.0* | 300.0* |
| 1536 | 19.0 | 80.0 | <1.0 | 2.8 | <0.01 | 17.0 | 18.0 |
| 1403 | 20.0 | 32.0 | 48.0 | 13.0* | 0.54* | 240.0* | 390.0* |
| 1366 | 3.0 | 49.0 | 48.0 | 7.8* | 0.60* | 240.0* | 350.0* |
| 1379 | 6.0 | 54.0 | 40.0 | 6.5* | 0.25 | 220.0* | 220.0* |
| 1539 | 11.0 | 39.0 | 50.0 | 3.5 | 1.1 | 70.0 | 120.0* |
| 1393 | 86.0 | 13.0 | 1.0 | 2.6 | 0.14 | 71.0 | 94.0 |
| 1394 | 81.0 | 10.0 | 1.0 | 1.2 | 0.08 | 200.0* | 98.0 |
| 202 | 62.0 | 20.0 | 18.0 | 1.3 | 0.04 | 21.0 | 34.0 |
| 1417 | 22.0 | 60.0 | 18.0 | <1.0 | 0.04 | 23.0 | 42.0 |
| 1360 | 21.0 | 49.0 | 15.0 | 4.5 | 0.44* | 220.0* | 24.0 |
| 1364 | 6.0 | 31.0 | 64.0 | 6.4* | 0.50* | 110.0* | 220.0* |
| MOE Guidelines | | | | 6.0 | 0.30 | 50 | 100.0 |

* equals or exceeds MOE Guidelines.

Table A.8 1978 Toronto Harbour Sediment Survey
(Depth Sampled was 0.0-5.0cm)

| Station Number | % Loss on Ignition | TP mg/g | TKN mg/g | Total PCB ng/g | Ni ug/g | Hg ug/g | Cd ug/g | Cr ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1345 | 4.7 | 1.8* | 1.5 | 2000* | 25.0* | 1.70* | 5.3* | 49.0* | 250.0* | 750.0* | 480.0* | 14500* |
| 1347 | 8.5* | 2.5* | 2.0* | 3300* | 40.0* | 4.20* | 7.8* | 200.0* | 280.0* | 1100.0* | 800.0* | 32400* |
| 1353 | 13.0* | 4.7* | 3.1* | 1910* | 71.0* | 7.00* | 10.0* | 390.0* | 370.0* | 1100.0* | 830.0* | 50000* |
| 1359 | 1.0 | 0.5 | 0.1 | ND | 3.0 | <0.01 | <0.3 | 4.0 | 2.2 | 4.5 | 17.0 | 100 |
| 1360 | 10.0* | 1.9 | 2.4* | 1850* | 40.0* | 1.70* | 6.5* | 140.0* | 280.0* | 840.0* | 740.0* | 22000* |
| 1379 | 1.9 | 1.0* | 0.8 | 280* | 11.0 | - | 0.6 | 20.0 | 22.0 | 74.0* | 100.0* | 2300* |
| 1383 | 3.3 | 0.8 | 0.9 | 670* | 11.0 | - | 1.2* | 33.0* | 29.0* | 110.0* | 130.0* | 4700* |
| 1401 | 5.8 | 0.6 | 0.6 | ND | 9.0 | 0.06 | 0.6 | 20.0 | 14.0 | 27.0 | 47.0 | 5500* |
| 1402 | 3.4 | 0.4 | 0.3 | ND | 6.8 | 0.06 | 0.4 | 12.0 | 9.8 | 19.0 | 36.0 | 800 |
| 1403 | 2.4 | 0.4 | 0.7 | ND | 6.2 | 0.05 | 0.3 | 12.0 | 8.5 | 16.0 | 38.0 | 630 |
| 1404 | 2.5 | 0.8 | 0.8 | 65* | 11.0 | 0.24 | 1.0* | 23.0* | 25.0* | 94.0* | 130.0* | 2400* |
| 1427 | 4.0 | 1.1* | 1.4 | 320* | 23.0 | 0.49* | 1.2* | 45.0* | 52.0* | 220.0* | 200.0* | 3700* |
| 1669 | 3.7 | 1.0* | 0.7 | 370* | 15.0 | 0.26 | 1.5* | 28.0* | 36.0* | 110.0* | 130.0* | 2180* |
| 1761 | 7.9* | 0.9 | 0.8 | ND | 18.0 | 0.15 | 0.7 | 35.0* | 34.0* | 4.4 | 89.0 | 1200 |
| 1762 | 1.6 | 0.5 | 0.3 | 10 | 5.8 | 0.03 | 0.4 | 11.0 | 6.8 | - | 46.0 | 400 |
| 1764 | 4.2 | 0.5 | 0.6 | 90* | 9.2 | 0.13 | 0.5 | 18.0 | 16.0 | 30.0* | 49.0 | 1400 |
| 1765 | 3.8 | 1.1* | 1.0 | 26 | 14.0 | 0.21 | 1.5* | 24.0 | 33.0* | 46.0* | 120.0* | 4000* |
| 1766 | 3.1 | 0.5 | 0.6 | 86* | 8.8 | 0.04 | 0.4 | 14.0 | 11.0 | 21.0 | 38.0 | 200 |
| 1767 | 2.6 | 0.6 | 0.65 | 11 | 5.8 | 0.02 | <3.0 | 10.0 | 6.2 | 12.0 | 22.0 | 510 |
| 1768 | 2.4 | 0.3 | 0.4 | ND | 6.8 | 0.02 | 0.4 | 10.0 | 9.2 | 17.0 | 35.0 | 690 |
| 1769 | 1.9 | 0.5 | 0.5 | 10 | 5.8 | 0.03 | <0.3 | 12.0 | 6.5 | 11.0 | 25.0 | 865 |
| 1770 | 2.8 | 0.4 | 0.5 | 10 | 5.0 | 0.03 | <0.3 | 8.8 | 6.5 | 9.8 | 26.0 | 3050* |
| 1771 | 1.2 | 0.3 | 0.5 | ND | 5.5 | 0.02 | <0.3 | 9.0 | 6.5 | 11.0 | 23.0 | 320 |
| 1772 | 1.3 | 0.3 | 0.2 | ND | 5.8 | 0.02 | <0.3 | 6.8 | 4.5 | 15.0 | 24.0 | 1130 |
| 1773 | 1.2 | 0.4 | 0.2 | ND | 4.0 | <0.01 | <0.3 | 5.8 | 2.2 | 9.5 | 21.0 | 160 |
| 1774 | 4.1 | 0.9 | 1.2 | 68* | 12.0 | 0.20 | 0.8 | 26.0* | 25.0* | 53.0* | 94.0 | 260 |
| 1776 | 2.5 | 0.6 | 0.9 | 180* | 8.2 | 0.10 | 0.4 | 11.0 | 14.0 | 50.0* | 72.0 | 2500* |
| 1777 | 1.6 | 0.5 | 0.7 | 160* | 6.0 | 0.11 | <0.3 | 9.5 | 8.3 | 8.0 | 32.0 | 800 |
| 1778 | 1.3 | 0.4 | 0.6 | 180* | 6.0 | 0.09 | 0.3 | 10.0 | 9.0 | 18.0 | 42.0 | 640 |
| 1779 | 1.0 | 0.5 | 0.6 | 200* | 4.0 | 0.06 | <0.3 | 6.0 | 7.5 | 9.5 | 24.0 | 660 |
| 1780 | <1.0 | 0.6 | 0.2 | - | 5.0 | <0.01 | <0.3 | 5.0 | 2.5 | 6.2 | 19.0 | 100 |
| 1781 | 8.8* | 1.6* | 3.1* | - | 26.0* | 0.45* | 2.2 | 61.0* | 61.0* | 140.0 | 240.0* | 4900* |
| 1782 | 2.4 | 1.0* | 1.0 | - | 12.0 | 0.14 | 0.7 | 26.0* | 25.0* | 48.0 | 88.0 | 2100* |
| 1783 | <1.0 | 0.3 | 0.1 | ND | 3.0 | ND | <0.3 | 6.0 | 1.8 | 3.0 | 20.0 | 170 |
| 1784 | 2.1 | 0.8 | 0.7 | - | 11.0 | 0.16 | 0.6 | 17.0 | 17.0 | 3.0 | 71.0 | 1200 |
| 1785 | <1.0 | 0.5 | 0.2 | 250* | 3.0 | - | <0.4 | 6.5 | 4.0 | 13.0 | 24.0 | 380 |
| MOE Guide-lines | 6.0 | 1.0 | 2.0 | 50 | 25.0 | 0.30 | 1.0 | 25.0 | 25.0 | 50.0 | 100.0 | 1500 |

* equals or exceeds MOE Guidelines.

ND Not detected.

\- No data.

Table A.9 1980 Keating Channel Sediment Survey
(Depth Sampled 0.0-10.0 cm)

| Station Number | % Sand | % Silt | % Clay | Loss on Ignition | TP mg/g | TKN mg/g | Al ug/g | Hg ug/g | Cr ug/g | Ni ug/g | Cu ug/g | Pb ug/g | Zn ug/g | Fe ug/g | Solvent Extract-ables ug/g | Total PBC's ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 77.0 | 20.3 | 5.5 | 1.60 | 0.83 | 0.60 | 2950 | 0.07 | 14.5 | 7.0 | 17.0 | 55.0* | 75.0 | 7900 | 590 | 13 |
| B | 92.6 | 7.5 | - | 0.45 | 0.68 | 0.19 | 1600 | 0.05 | 8.0 | 3.5 | 7.0 | 24.0 | 41.0 | 6000 | 390 | 11 |
| C | 93.3 | 6.7 | - | 0.70 | 0.46 | 0.21 | 1850 | 0.03 | 8.8 | 5.6 | 11.0 | 35.0 | 52.0 | 5350 | 455 | 12 |
| 1379 | 92.1 | 7.0 | 2.2 | 0.93 | 0.65 | 0.23 | 1800 | 0.04 | 10.0 | 4.0 | 12.0 | 32.0 | 48.0 | 6050 | 1235 | 36 |
| E | 29.2 | 54.6 | 15.8 | 4.90 | 1.22* | 1.35 | 9400 | 0.15 | 33.5* | 20.0 | 42.0* | 180.0* | 205.0* | 16000* | 4930* | 235 |
| 1375 | 78.7 | 18.4 | 5.1 | 2.00 | 0.75 | 0.49 | 3400 | 0.05 | 11.5 | 6.9 | 14.0 | 39.0 | 59.0 | 7550 | 2265* | 85 |
| 1376 | 13.1 | 74.4 | 12.6 | 4.50 | 1.15* | 1.20 | 11000 | 0.09 | 34.5* | 21.5 | 43.0* | 155.0* | 190.0* | 17500* | - | 515 |
| 1369 | 11.8 | 61.1 | 27.1 | 6.30* | 1.35* | 1.55 | 12000 | 0.25 | 46.5* | 24.5 | 65.0* | 265.0* | 290.0* | 19500* | 8970* | 225 |
| MOE Guidelines | | | | 6.0 | 1.0 | 2.0 | | 0.30 | 25.00 | 25.0 | 25.0 | 50.0 | 100.0 | 10000 | 1500 | 50 |

* equals or exceeds MOE Guideline.

ND Not detected.

\- No data.

Table A.10 1982 Eastern Beaches Sediment Survey

| Station Number | % Sand | % Silt | % Clay | % Loss on Ignition | TKN mg/g | TOC mg/g | TP mg/g | As ug/g | Cr ug/g | Cu ug/g | Hg ug/g | Pb ug/g | Zn ug/g | Solvent Extract-ables ug/g | Total PCB ng/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2186 | 97.8 | 0.2 | 1.9 | 0.6 | 0.1 | 1.10 | 0.3 | 1.14 | 6.6 | 5.9 | <0.01 | 3.2 | 16.0 | 830 | <20 |
| 2187 | 97.0 | 0.1 | 2.9 | 0.3 | 0.1 | 0.32 | 0.4 | 0.72 | 3.9 | 1.8 | <0.01 | 3.0 | 11.0 | 120 | <20 |
| 2188 | 98.0 | 0.1 | 1.9 | 0.4 | 0.1 | 0.52 | 0.3 | 0.91 | 4.5 | 2.7 | <0.01 | 3.2 | 12.0 | 240 | <20 |
| 2189 | 97.3 | 0.1 | 1.0 | 0.3 | 0.1 | 0.36 | 0.4 | 1.00 | 4.7 | 2.8 | <0.01 | 3.2 | 9.8 | 380 | <20 |
| 2190 | 97.5 | 1.6 | 0.0 | 0.9 | 0.1 | 1.80 | 0.3 | 1.91 | 8.9 | 9.8 | <0.01 | 4.2 | 18.0 | 180 | <20 |
| 2191 | - | - | - | 1.1 | 0.2 | 2.30 | 0.3 | 6.79 | 7.8 | 6.2 | <0.01 | 9.0 | 24.0 | 470 | <20 |
| 2197 | 94.0 | 3.6 | 1.9 | 0.6 | 0.2 | 1.1 | 0.6 | 1.19 | 9.4 | 8.7 | <0.01 | 13.0 | 27.0 | 1620* | <20 |
| 2198 | 96.7 | 0.8 | 1.9 | 0.3 | 0.2 | 1.0 | 0.4 | 1.72 | 3.6 | 2.9 | <0.01 | 8.8 | 16.0 | 330 | <20 |
| 2199 | 96.2 | 1.4 | 0.0 | 0.7 | 0.2 | 1.0 | 0.3 | 3.31 | 7.0 | 5.8 | <0.01 | 10.0 | 28.0 | - | <20 |
| 2200 | 97.3 | 1.6 | 0.0 | 1.3 | 0.4 | 6.8 | 0.7 | 13.75* | 12.0 | 9.5 | <0.01 | 24.0 | 62.0 | 310 | <20 |
| 2201 | 97.6 | 1.3 | 1.0 | 0.4 | 0.1 | 1.2 | 0.4 | 2.65 | 7.0 | 3.6 | <0.01 | 12.0 | 21.0 | 490 | <20 |
| 2202 | - | - | - | 0.8 | 0.1 | 1.7 | 0.4 | 6.73 | 5.8 | 6.7 | <0.01 | 10.0 | 24.0 | - | <20 |
| 2203 | 82.5 | 14.7 | 1.3 | 1.0 | 0.1 | 2.5 | 0.6 | 1.62 | 7.6 | 8.9 | <0 01 | 12.0 | 22.0 | 1230 | <20 |
| 2204 | 81.9 | 4.5 | 1.9 | 0.7 | 0.1 | 1.0 | 1.0* | 1.43 | 8.8 | 5.7 | <0.01 | 8.8 | 15.0 | 230 | <20 |
| 2205 | 96.6 | 0.6 | 1.9 | 0.6 | 0.1 | 1.0 | 0.3 | 1.96 | 5.1 | 4.3 | <0.01 | 9.0 | 20.0 | 340 | <20 |
| 2208 | 95.6 | 3.4 | 1.0 | 0.1 | 0.1 | 1.0 | 1.0* | 1.10 | 5.4 | 2.5 | <0.01 | 4.9 | 13.0 | 310 | <20 |
| 2209 | 90.6 | 4.7 | 3.9 | 0.6 | 0.1 | 1.0 | 0.4 | 1.38 | 5.3 | 5.2 | <0.01 | 6.2 | 13.0 | 310 | <20 |
| 2210 | 97.0 | 1.1 | 1.9 | 0.2 | 0.1 | 1.0 | 0.5 | 1.00 | 3.3 | 2.6 | <0.01 | 5.7 | 7.6 | 3170* | <20 |
| 2211 | 96.5 | 4.4 | 2.9 | 0.2 | 0.1 | 1.0 | 0.8 | 0.88 | 6.1 | 2.5 | <0.01 | 4.5 | 13.0 | 390 | <20 |
| 2212 | 96.0 | 1.2 | 2.8 | 0.1 | 0.1 | 1.0 | 1.1* | 0.91 | 7.3 | 4.5 | <0.01 | 7.2 | 14.0 | 2270* | <20 |
| 2213 | 94.0 | 2.1 | 3.9 | 0.2 | 0.1 | 1.0 | 1.1* | 1.14 | 5.1 | 3.0 | <0.01 | 7.7 | 11.0 | 370 | <20 |
| 2214 | 94.9 | 2.2 | 2.9 | 0.2 | 0.2 | 1.0 | 1.9* | 1.10 | 7.6 | 2.5 | <0.01 | 7.2 | 14.0 | 410 | <20 |
| 2215 | 91.9 | 4.2 | 3.9 | 0.1 | 0.2 | 1.0 | 1.2* | 0.86 | 6.0 | 2.5 | 0.1 | 3.9 | 11.0 | - | <20 |
| 2216 | 97.3 | 0.6 | 1.9 | 0.2 | 0.2 | 1.0 | 1.4* | 1.10 | 6.3 | 1.0 | <0.01 | 2.8 | 12.0 | 20 | <20 |
| 2217 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <20 |
| 2218 | 98.9 | 0.1 | 1.0 | 0.4 | 0.2 | 1.0 | 0.5 | 1.14 | 5.9 | 4.1 | <0.01 | 4.5 | 21.0 | 280 | <20 |
| 2219 | 72.6 | 13.6 | 10.8 | 1.3 | 0.5 | 5.5 | 0.9 | 1.91 | 22.0 | 15.0 | 0.02 | 14.0 | 35.0 | 1000 | 25 |
| 2220 | 94.2 | 1.7 | 3.9 | 0.2 | 0.2 | 1.0 | 1.4* | 1.00 | 20.0 | 3.8 | <0.01 | 3.0 | 20.0 | 2370* | <20 |
| 2221 | 80.7 | 1.4 | 1.9 | 0.8 | 0.30 | 1.0 | 0.50 | 1.91 | 9.4 | 5.0 | <0.01 | 5.2 | 17.0 | 340 | <20 |
| MOE Guidelines | | | | 6.0 | 2.0 | 10.0** | 1.0 | 8.0 | 25.0 | 25.0 | 0.30 | 50.0 | 100.0 | 1500 | 50 |

* Equals or exceeds MOE Guidelines.

ND Not detected.
\- No data.
** Interim Guideline.